ALESSANDRO D'ATRI
MARCO DE MARCO
NUNZIO CASALINO
Editors

Interdisciplinary Aspects of Information Systems Studies

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Alessandro D'Atri • Marco De Marco
Nunzio Casalino

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The Italian Association for Information Systems

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Professor Alessandro D'Atri
CeRSI
Via G. Alberoni 7
00198 Roma
Italy
datri@luiss.it

Professor Marco De Marco
Università Cattolica del Sacro Cuore
Largo Gemelli 1
20123 Milano
Italy
marco.demarco@unicatt.it

Dr. Nunzio Casalino
CeRSI
Via G. Alberoni 7
00198 Roma
Italy
ncasalino@luiss.it

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Contributors

M. Agosti
Università di Padova, Dipartimento di Ingegneria dell'Informazione, Padua, Italy, agosti@dei.unipd.it

P. L. Agostini
Università Cattolica del Sacro Cuore, Milano, Italy, pietroluca.agostini@unicatt.it

V. Albano
Università LUISS – Guido Carli, CeRSI – Centro di Ricerca sui Sistemi Informativi, Roma, Italy, valbano@luiss.it

S. Armenia
Università di Tor Vergata, Roma, Italy, armenia@disp.uniroma2.it

A. Augello
Università degli Studi di Palermo, DINFO, Dipartimento di Ingegneria Informatica, Palermo, Italy, augello@csai.unipa.it

S. Basaglia
Università Bocconi, Milano, Italy, stefano.basaglia@unibocconi.it

C. Batini
Università degli Studi di Milano Bicocca, Milano, Italy, batini@disco.unimib.it

A. Bechini
Università di Pisa, Pisa, Italy, a.bechini@ing.unipi.it

P. M. Bednar
Lund University, Department of Informatics, Sweden; University of Portsmouth, School of Computing, Hampshire, UK, peter.bednar@ics.lu.se

M.C. Benfatto
Università LUISS – Guido Carli, Roma, Italy, mcbenfatto@luiss.it

D. Bianchini
Università di Brescia, Dipartimento di Elettronica per l'Automazione, Brescia, Italy, bianchin@ing.unibs.it

T. Bouron
France Télécom R&D Division, Sophia Antipolis, France, thierry.bouron@orange-ftgroup.com

A. M. Braccini
Università LUISS – Guido Carli, CeRSI – Centro di Ricerca sui Sistemi Informativi, Roma, Italy, abraccini@luiss.it

M. R. Cagnina
Università di Udine, Dipartimento di Economia, Udine, Italy, cagnina@uniud.it

D. Canini
Università di Tor Vergata, Roma, Italy, stitch7@alice.it

L. Caporarello
Università Bocconi, Milano, Italy, leonardo.caporarello@unibocconi.it

C. Cappiello
Politecnico di Milano, Milano, Italy, cappiell@elet.polimi.it

E. Capra
Politecnico di Milano, Dipartimento di Elettronica e Informazione, Milano, Italy, capra@elet.polimi.it

U. Carletti
SELEX Sistemi Integrati SpA, Stabilimento Fusaro, Bacoli (NA), Italy

A. Carugati
IESEG Business School Lille, France – Aarhus School of Business, Aarhus Denmark, andreac@asb.dk

N. Casalino
Università LUISS – Guido Carli, Roma, Italy, ncasalino@luiss.it

M. Cavallari
Università Cattolica del Sacro Cuore, Milano, Italy, maurizio.cavallari@unicatt.it

M. Cesarini
Università degli Studi di Milano Bicocca, Dipartimento di Statistica, Milano, Italy, mirko.cesarini@unimib.it

D. Cherubini
Università degli Studi di Milano Bicocca, Milano, Italy, daniela.cherubini@unimib.it

P. Ciancarini
Università di Bologna, Dipartimento di Scienze dell'Informazione, Bologna, Italy

M. Comuzzi
Politecnico di Milano, Dipartimento di Elettronica e Informazione, Milan, Italy, comuzzi@elet.polimi.it

M. Contenti
Università LUISS – Guido Carli, CeRSI – Centro di Ricerca sui Sistemi Informativi, Roma, Italy, mcontenti@luiss.it

A. Cordella
London School of Economics, London, UK, acordella@lse.ac.uk

V. Corvello
Università della Calabria, Dipartimento di Scienze Aziendali, Arcavacata di Rende, Cosenza, Italy, corvello@unical.it

A. D'Atri
Università LUISS – Guido Carli, CeRSI – Centro di Ricerca sui Sistemi Informativi, Roma, Italy, datri@luiss.it

E. D'Avanzo
Università di Salerno, Fisciano, Salerno, Italy, edavanzo@unisa.it

V. De Antonellis
Università di Brescia, Dipartimento di Elettronica per l'Automazione, Brescia, Italy, deantone@ing.unibs.it

M. De Marco
Università Cattolica del Sacro Cuore, Dipartimento di Scienze dell'Economia e della Gestione Aziendale, Milano, Italy, marco.demarco@unicatt.it

A. De Nicola
CNR - Isituto di Analisi dei Sistemi ed Informatica "A. Ruberti", Roma, Italy, denicola@iasi.cnr.it

P. Depaoli
Università di Urbino, Urbino, Italy, paolo.depaoli@uniurb.it

A. Di Leva
Università di Torino, Dipartimento di Informatica, Torino, Italy, dileva@di.unito.it

M.R. Di Renzo
Università LUISS – Guido Carli, Roma, Italy, mrdirenzo@luiss.it

A. Elia
Università di Salerno, Fisciano, Salerno, Italy, aelia@unisa.it

M. Ettorre
Università della Calabria, Exeura s.r.l., Arcavacata di Rende, Cosenza, Italy, ettorre@exeura.it

A. Ferrari
Università LUISS – Guido Carli, Roma, Italy, antonella.ferrari@economia.univr.it

S. Ferrari
Università Cattolica del Sacro Cuore, Piacenza, Italia, stefano.ferrari@isbs.it

N. Ferro
Università di Padova, Dipartimento di Ingegneria dell'Informazione, Padua, Italy, ferro@dei.unipd.it

P. Fierro
Università di Salerno, Salerno, Italy, fierrop@unisa.it

F. Folino
CNR - ICAR, Rende, Italy, ffolino@icar.cnr.it

C. Francalanci
Politecnico di Milano, Milano, Italy, francala@elet.polimi.it

A. Francesconi
Università di Pavia, Pavia, Italy, afrancesconi@eco.unipv.it

M.G. Fugini
Politecnico di Milano, Dipartimento di Elettronica e Informatica, Milano, Italy, fugini@elet.polimi.it

S. Gaglio
Università degli Studi di Palermo, Dipartimento di Ingegneria Informatica, Palermo, Italy
CNR - ICAR, Palermo, Italy, gaglio@unipa.it

P. Giacomazzi
Politecnico di Milano, Dipartimento di Elettronica e Informazione, Milano, Italy, giacomaz@elet.polimi.it

G. Greco
Università della Calabria, Dipartimento di Matematica, Arcavacata di Rende, Cosenza, Italy, greco@mat.unical.it

A. Gualtieri
Università della Calabria, DEIS, Arcavacata di Rende, Cosenza, Italy, gualtieri@exeura.it

N. Guarino
CNR - ISTC, Trento, Italy

A. Guzzo
Università della Calabria, DEIS, Arcavacata di Rende, Cosenza, Italy, guzzo@deis.unical.it

M. Helfert
Dublin City University, Dublin, Ireland, markus.helfet@computing.ie

R.T. Høegh
Aalborg University, Department of Computer Science, Denmark, runethh@cs.aau.dk

B. Imperatori
Università Cattolica del Sacro Cuore, Milano, Italy, barbara.imperatori@unicatt.it

D. Isari
Università Cattolica del Sacro Cuore, Milano, Italy, daniela.isari@unicatt.it

M. F. Izzo
Università LUISS – Guido Carli, Roma, Italy, fizzo@luiss.it

S. L. Jarvenpaa
University of Texas at Austin, McCombs School of Business – Center for Business Technology and Law, Austin, TX, USA, sirkka.jarvenpaa@mccombs.utexas.edu

T. Kuflik
The University of Haifa, Haifa, Israel, tsvikak@mis.hevra.ac.it

P. Laguzzi
Università di Torino, Dipartimento di Informatica, Torino, Italy, laguzzi@di.unito.it

M. Lenzerini
Università di Roma "La Sapienza", Dipartimento di Informatica e Sistemistica "Antonio Ruberti", Roma, Italy

A. Lieto
Università di Salerno, Fisciano, Salerno, Italy, alieto@unisa.it

P. Maggiolini
Politecnico di Milano, Dipartimento di Ingegneria Gestionale, Milano, Italy, piercarlo.maggiolini@polimi.it

M. Magni
Università Bocconi, Milano, Italy, massimo.magni@unibocconi.it

L. Marchegiani
Luiss Business School, Roma, Italy, lmarchegiani@luiss.it

A.G. Marinelli
Università LUISS – Guido Carli, Roma, Italy, agmarinelli@luiss.it

L. Martiniello
Università LUISS – Guido Carli, Roma, Italy, lmartiniello@luiss.it

A. Martone
LIUC Università Carlo Cattaneo - Castellanza, Varese, Italy, amartone@liuc.it

G. Mazzone
Università LUISS – Guido Carli, Roma, Italy, gmazzone@luiss.it

F. Merlo
Politecnico di Milano, Dipartimento di Elettronica e Informazione, Milano, Italy, merlo@elet.polimi.it

M. Mezzanzanica
Università degli Studi di Milano Bicocca, Dipartimento di Statistica, Milano, Italy, mario.mezzanzanica@unimib.it

P. Migliarese
Università della Calabria, Dipartimento di Scienze Aziendali, Arcavacata di Rende, Cosenza, Italy, piero.migliarese@unical.it

E. Minelli
LIUC Università Carlo Cattaneo - Castellanza, Varese, Italy, eminelli@liuc.it

M. Missikoff
CNR - Isituto di Analisi dei Sistemi ed Informatica “A. Ruberti”, Roma, Italy, missikoff@iasi.cnr.it

L. Mola
Universita di Verona, Verona, Italy, lapo.mola@univr.it

E. Mollona
Università di Bologna, Dipartimento di Scienze dell’Informazione, Bologna, Italy

U. Montanari
Università di Pisa, Dipartimento di Informatica, Pisa, Italy

V. Morabito
Università Bocconi, Milano, Italy, vincenzo.morabito@uni-bocconi.it

C. Morelli
LIUC Università Carlo Cattaneo - Castellanza, Varese, Italy and Università del Piemonte Orientale, Italy, cmorelli@liuc.it

G. Motta
Università di Pavia, Pavia, Italy, gianmario.motta@unipv.it

P. Naggar
CM Sistemi SpA, Roma, Italy

R. Naggi
Università LUISS – Guido Carli, Roma, Italy, raffaella.naggi@tin.it

K. Nanini
Politecnico di Milano, Dipartimento di Ingegneria Gestionale, Milano, Italy

F. Pennarola
Università Bocconi, Milano, Italy, ferdinando.pennarola@unibocconi.it

A. Perego
SDA Bocconi – School of Management, Milano, Italy,
angela.perego@sdabocconi.it

B. Pernici
Politecnico di Milano, Milano, Italy, barbara.pernici@polimi.it

F. Pigni
France Télécom R&D Division, Sophia Antipolis, France, fpigni@liuc.it

G. Pilato
CNR - ICAR, Palermo, Italy, g.pilato@icar.cnr.it

M. Poian
Università di Udine, Dipartimento di Economia, Udine, Italy,
michele.poian@uniud.it

A. Poli
Politecnico di Milano, Dipartimento di Elettronica e Informazione, Milano, Italy,
poli@elet.polimi.it

L. Pontieri
CNR - ICAR, Rende, Italy, pontieri@icar.cnr.it

R. Preziosi
Università di Salerno, Fisciano, Salerno, Italy, rpreziosi@unisa.it

A. Ravarini
LIUC Università Carlo Cattaneo – Castellanza, Varese, Italy, aravarini@liuc.it

A. Resca
Università LUISS – Guido Carli, CeRSI – Centro di Ricerca sui Sistemi
Informativi, Roma, Italy, aresca@luiss.it

F. Ricciardi
Università Cattolica del Sacro Cuore, Brescia, Italy, francesca.ricciardi@unicatt.it

C. Rossignoli
Universita di Verona, Verona, Italy, cecilia.rossignoli@univr.it

P. Roveri
Business Integration Partners, Italy, paolo.roveri@mail-bip.com

M. Ruffolo
CNR - ICAR, Pisa, Italy, ruffolo@icar.cnr.it

V.S. Runchella
Università LUISS – Guido Carli, CeRSI – Centro di Ricerca sui Sistemi Informativi, Roma, Italy, vscaffidi@luiss.it

D. Saccà
Università della Calabria, Arcavacata di Rende, Cosenza, Italy, sacca@unical.it
CNR - ICAR, Rende, Italy, sacca@icar.cnr.it

M. Sebastianis
THINK3 Inc., Casalecchio di Reno (BO), Italy

M. Sorrentino
Università degli Studi di Milano Dipartimento di Scienze Economiche, Aziendali e Statistiche, Milano, Italy, maddalena.sorrentino@unimi.it

P. Spagnoletti
Università LUISS – Guido Carli, CeRSI – Centro di Ricerca sui Sistemi Informativi, Roma, Italy, pspagnoletti@luiss.it

D. Talia
Università della Calabria, DEIS, Via P. Bucci 41C, 87036 Rende, Italy

L. Tininini
CNR - Isituto di Analisi dei Sistemi ed Informatica “A. Ruberti”, Roma, Italy, tininini@iasi.cnr.it

A. Tomasi
Università di Pisa, Pisa, Italy, andrea.tomasi@iet.unipi.it

G. Vassallo
Università degli Studi di Palermo, DINFO, Dipartimento di Ingegneria Informatica, Palermo, Italy, gvassallo@unipa.it

C.D. Vecchio
Università LUISS – Guido Carli, Roma, Italy, cdelvecchio@luiss.it

F. Vicentini
Luiss Business School, Roma, Italy, fvicentini@luiss.it

J. Viotto
Università di Pisa, Pisa, Italy, jacopo.viotto@iet.unipi.it

R. Virtuani
Università Cattolica del Sacro Cuore, Piacenza, Italia, roberta.virtuani@unicatt.it

G. Viscusi
Università degli Studi di Milano Bicocca, Milano, Italy, viscusi@disco.unimib.it

C. Welch
University of Portsmouth, Department of Strategy and Business Systems, Hampshire, UK, christine.welch@port.ac.uk

Introduction

A. D'Atri[1] **and M. De Marco**[2]

When reading The Roaring Nineties [1], in which the author illustrates his theoretical framework based on the concept of asymmetric information, one realizes that the creation of shareholder value – a cornerstone of modern market economic theory – was not the main driver of top management decisions in those years. Among others, the remuneration of management by means of stock options actually played a key role in disguising the real performances of several companies, including many fast-growth "dotcoms." Even though the phenomenon had been debated among policymakers, regulators and economists, and between them and the industry leaders, the deregulation paradigm prevailed and the extensive use of stock options is now recognized as one of the triggers of the "New Economy" crisis.

That leads us to draw two conclusions: (a) that the outcomes of complex developing phenomena are difficult to understand ex ante, even by domain experts (Stiglitz himself admits that, at the time, he did not take a strong enough stand to regulate such a practice); and (b) that the stakeholders (managers) who – according to the dominant theories – are supposed to be substantially supportive of other stakeholders' interests (shareholders) become their antagonists, given certain prevailing policymaking paradigms.

Of course, ICTs are themselves a complex phenomenon, given their role as both an important driver of the world economy and a crucial input factor for other industries (especially in terms of IS deployment). On the one hand, ICTs are affected by the economic context and the disciplines that study them (e.g., micro and macroeconomics, international economics, financial economics, etc.) through the decisions implemented by the ICT firms, which formulate their strategies and actions based on economic analyses.

On the other, ICT-IS help determine the complexity of the "world of economy," in both the ontological sense (directly, since the industry is an important economic

[1]Università LUISS – Guido Carli, CeRSI – Centro di Ricerca sui Sistemi Informativi, Roma, Italy, datri@luiss.it
[2]Università Cattolica del Sacro Cuore, Dipartimento di Scienze dell'Economia e della Gestione Aziendale, Milano, Italy, marco.demarco@unicatt.it

driver, and indirectly, because it produces tools that enable firms to network with customers and suppliers) and the epistemological sense (e.g., the contribution of APL in implementing the regression techniques used in econometrics).

In addition, such a complex ICT-IS universe is spurring growth in the number of stakeholders, as well as the quality and quantity of the different users (who now adopt an eclectic range of applications: from e-shopping and internet banking using a home computer to B2B and healthcare imaging to infomobility and its impact on organizing the work of the sales force or in selling car insurance policies, to name just a few). Therefore, that interplay between the different stakeholder groups creates the pressure to introduce, to evolve, or to ease the regulatory activities: activities that are influenced by the ICT and domain experts and by the prevailing theories from which these latter take their cue. Such activities – which lead to a cooperation consisting of diverse degrees of implicit or explicit conflict – take place at both the macrolevel (governmental) and the microlevel (governance and management of individual organizations). This "interaction" among "agents" and with the existing social, societal, and technological "structure" has raised several questions in the long-running debate on the primacy of structure or, conversely, of human agency or a more balanced vision between the two extremes [2]. Naturally, the stance taken by the relevant stakeholders in that debate can change the way ICT-IS strategies and projects are conceived and developed.

We have drawn on the work of an economist and a sociologist to exemplify how certain phenomena or concepts – relevant to the IS world, and, therefore, to the IS discipline – can be highlighted depending on the different perspectives or the work approach adopted by the various disciplines. The collective work presented here focuses on the interdisciplinary approach, by which we mean the need to harness a number of diverse disciplines in both the theory and the practice of information systems. The contributions aim to highlight the indications (and, naturally, the research) deriving from the many factors that connect IS successes and failures to their design and implementation. In essence, tracing these to the contexts in which they are "invented" and used, and to the array of needs they are supposed to satisfy, especially given that the more complex the projects, the harder it is to envisage ex ante their outcomes, and, therefore, the more open-minded the IS actors have to be.

The aim is not to define a set of relations between different disciplines and, thus, guidelines useable by IS theory and practice, as if further effectiveness could be promoted in such a guise. Indeed, the spectrum of fields in which IS are employed is far too large and diversified in scope, in terms of user needs and types of organizations, that only a reductionist approach – too strong to be effective – could lead to such guidelines. Rather, we want to appeal to the sensitivity and curiosity of the researchers and practitioners by proposing a series of events that would enable them to reflect on their expertise: an expertise that is likely to become increasingly multifaceted and perceptive to different kinds of stimuli.

The 49 contributions – whose authors were asked to prepare a short essay conveying their core ideas in an agile manner – are divided into eight sections.

The first section "IS Theory and Research Methodologies" focuses on the development of an interesting debate in the IS discipline that seeks to explore its

boundaries and the diverse theoretical approaches that study the interaction between technology, organization, and society, in order to better understand the diffusion of ICT-IS technologies (and their reshaping by both society and single organizations). The section highlights some key results of the interaction between IS research and philosophy.

The second section "IS Development and Design Methodologies" tracks the evolution of IS infrastructure design and shows the need to deal with an increasingly large variety of topics, from legal to economic to organizational, as well as outlining the appropriate methodologies for human-intensive systems, business process modeling, usability evaluations, and services.

Given the need to invest in IT to support the competitiveness of firms in the current fast-changing environment, the third section "Organizational Change and the IT Impact" considers the issues related to a permanent implementation of information systems: elements that affect the adoption of technologies; formal and informal organizational consequences of technological innovation – from the changing role of IT managers and professionals to the emergence of new psychological contracts in work relationships; critical aspects of IT process outsourcing and change; and using ICT to manage uncertainty in organizations.

The fourth section is dedicated to "Information Systems in Engineering and Computer Science" and sets out the research topics that aim to support the modeling of IS processes, describing and indicating approaches to knowledge sharing and ontology based peer-to-peer exchanges.

Section five "Governance, Metrics and Economics of IT" addresses what, for management, is a major field of concern. The vast array of components that converge in the building of an organization's IT system requires that the CIOs not only make a careful search for the appropriate measures and the adequate tools, but also possess special expertise in the field. The contributions in this section take into account cost-effective solutions and trade-offs, indicate best practices along with the possible profile of innovative IT managers, describe the role of performance management systems, and consider the methodological side of evaluating IT solutions and their impacts.

In "Education and Training in Information Systems", the researchers examine formal educational issues through a survey of IS curricula in economics studies and on-the-job bottom-up approaches for improving security by leveraging user culture, before presenting the application of an e-learning "blended" solution to managerial skills.

Section 7 "Information and Knowledge Management" explores possible ways to surpass the solely data-centred KM strategies and applications by leveraging organizational knowledge. The contributions consider principles for finding psychological drivers; illustrate the emergence of spontaneous practices of knowledge sharing; and present techniques for enhancing cooperation processes in networks of enterprises.

Finally, Sect. 8 "E-Services in the Public and Private Sectors" examines possible models and solutions to increase service use and enhance customer relationship management beyond the merely cost-saving effects favored by higher

levels of automation. The contributions approach a range of issues: electronic identification management; the importance of stakeholders involvement in paper dematerialization processes in the public sector; procurement processes; the role of business models; and the opportunities sparked by web 2.0.

References

1. Stiglitz, J.E. (2003) The Roaring Nineties: A New History of the World's Most Prosperous Decade. New York, Norton
2. Giddens, A. (1984) The Constitution of Society. Outline of the Theory of Structuration. Cambridge, Polity Press

Part I
Is Theory and Research Methodologies

A. Cordella

Due to the interdisciplinary nature of the IS discipline which aims more and more at studying the interaction between technology and human actors there is an increased need to explore new theoretical an methodological research guidelines. The theoretical boundaries of IS have become less defined since the interactions among management science, organizational studies, social sciences, and economic science as informative approaches to study the interaction between information technologies, organization, and society. The importance of exploring new theoretical approaches, methods, and models to study this interaction has generated and interesting debate within the IS discipline. This track is focused on investigating about the developing of IS research theories and methods, trying to enrich the debate and provide new and innovative approaches to study how technology get used, adopted, diffused, and shaped in organization and society. Topics include (but are not limited to): Epistemological and ontological principles of IS research Different patterns of use of IS research theory Qualitative vs. quantitative research methods Positive, interpretative and critical research in IS field Organizational vs. IS research methods Strategies for linking theory and practice Core theories of IS.

London School of Economics, London, UK, acordella@lse.ac.uk

Interdisciplinarity and Its Research: The Influence of Martin Heidegger from 'Being and Time' to 'The Question Concerning Technology'

P. Depaoli

Abstract The paper deals with interdisciplinarity by exploring the interaction between philosophy and IS theory and its consequences for developing a research agenda in IS design and implementation. The focus is on the influence of Heidegger on the work of Dreyfus, Winograd and Flores, and Ciborra. To gain a better insight on the German philosopher, comments by Latour and Ihde were also considered. The results show that there are several issues that have been enlightened by the 'interaction' of IS scholars with Heidegger: concepts such as 'un-intentionality', 'pre-understanding', and 'breakdown' of everyday activities – as well as the importance of 'moods' for an effective understanding of user needs – have all been underlined so that exchanges among actors can lead to better design. Thus IS research needs a renewed attention to human resources management of IS experts and users together with the study of how 'decentralized' approaches to IS projects can be promoted.

Introduction

In this paper interdisciplinarity is considered to be the result of an exchange of ideas and experiences from different perspectives and fields so that 'interstices between disciplines' can be exploited [1, p. 8] to increase the possibilities of coping successfully with issues involving Information Systems (IS). Given the growing pervasiveness of IS it is likely for such interstices to become wider (open to new kinds of approaches), deeper (increasingly attentive to epistemological or philosophical issues) weightier (progressively more relevant for policy making).

The aim of the paper is to explore some examples of cross fertilization between philosophy (specifically Heidegger) and IT-IS and their relevance for IS design and implementation. Three 'combinations' have been considered: Heidegger and the interpretation/use of his works made by Dreyfus, Winograd and Flores, and Ciborra,

Università di Urbino, Urbino, Italy, paolo.depaoli@uniurb.it

known for their being engaged in key IS issues and for their familiarity with Heidegger. More limited in scope, aim, and extension with respect to the work of Introna and Ilharco [2], it considers the possible contour of priorities for a research program within the construction of an IS management agenda.

The paper is divided into four sections. The first one explains the method adopted in searching for Heidegger's influence. The second section "The Methodology Adopted" shows some of the significant 'interactions' between the authors and the philosopher. The third one focuses on some of Heidegger's concepts previously referred to and confronts them with some remarks and interpretations by Latour and Ihde. The final section "Outcomes" comments on the work done.

The Methodology Adopted

It could be pedantic and even useless to trace the specific origin of a single contribution when a general indebtedness is sufficient to trace the encounter between authors [3]. In this case though it is necessary to trace the exact references made by the authors for two reasons: (a) an 'aura' was not sufficient to show the consequences deriving from the combination philosopher/scholar; (b) the specific and precise but at times awkward terminology used by Heidegger needed exact quotations to show the 'fit' between the issue at stake and the reference to his work.

'Interactions' with Heidegger

Dreyfus, Un-Intentionality and Learning

In the following passage Dreyfus [4] summarizes Heidegger's explanation of how we can be engaged in non deliberate actions and however orientate our actions (while, at the same time, being ready for uncommon or demanding tasks). The point is that in a 'calculative way of thinking' (in a world dominated by strict cause-effect relationships) it is not possible to explain how this happens unless we presuppose that our actions are sequenced in the pursuit of some goal.

> "Heidegger uses the term 'the for-the-sake-of-which' to call attention to the way human activity makes long term sense … A for the-sake-of-which, like *being* a father or *being* a professor is not to be thought as a goal I have in mind and can achieve. … rather [it is] a self-interpretation that informs and orders all my activities.
>
> As a first approximation, we can think of the for-the-sake-of-whichs to which [man] 'assigns itself' as social 'roles' and 'goals', but Heidegger never uses the term 'roles' and 'goals'. When I am successfully coping, my activity can be seen to have a point, but I need not to have any *goal*, let alone a long-range life *plan* as AI researchers like Roger Schank suppose" [4, p. 95]

The issue raised in the last part of the quotation belongs to the long lasting controversy that has opposed Dreyfus [5] to the advocates of Artificial Intelligence where the former claimed that the production of intelligence through the use of facts and rules has not generated results. And it couldn't possibly have done so. In fact all evidence (and philosophical considerations such as the ones in the above mentioned passage) seem to contradict the assumption that the human mind 'functions like a digital computer' [ibid. p. 189]: for example one can ride a bicycle[1] without knowing the laws that govern its motion along a winding road so that formalization (the laws) is not the same as the rider's performance; in other words, 'there cannot be a *theory* of human performance' [ibid. p. 191]. In Dreyfus' Commentary on *Being and Time* [4] it is possible to grasp a number of interesting consequences if one does not believe in the possibility of formalizing human behavior: (a) the weight of un-intentionality (and as we shall see with Ciborra's work, of passions) and socialization in people's comportment; (b) the intertwining between people's way of being and the practices they follow, along with the equipment they use

> "… [F]or-the-sake-of-whichs need not be intentional at all. I pick up my most basic life-organizing self-interpretations by socialization, not by choosing them. For example, one behaves as an older brother or a mama's girl without having chosen these organizing self-interpretations, and without having them in mind as specific purposes. These ways of being lead one to certain organized activities such as being a teacher, nurse, victim, etc. Each such role is an integrated set of practices: one might say 'a practice', as in the practice of medicine. And each practice is connected with e lot of equipment for practicing it. [Man] inhabits or dwells in these practices and their appropriate equipment; in fact [man] takes a stand on its being by being a more or less integrated subpattern of social practices." [4, p. 96]

These considerations, as it will be shown in the last paragraph, are relevant to address several issues connected with higher level learning like the (limited) possibilities of gaining knowledge through 'distance' [6].

Winograd and Flores: Computing as Communicating

> " 'Can computers think?', 'Can computers understand language?', and 'What is rational decision-making?'. We address these questions not so much to solve them as to *dissolve* them." [7, p. xiii].

Their whole book is dedicated to show that it is misleading both to conceive thinking as a linguistic manipulation of representations and to interpret human action on rationalistic grounds: just like for Dreyfus, this explains the failure of some computer programs [ibid p. 178]. The alternative view is to conceive (and therefore design) computers, on the one hand, as 'tools for conducting the network of conversations' [ibid p. 172] and, on the other hand, as useful representations of systematic domains

[1] The example of the bicycle rider, as Dreyfus writes in a footnote, is taken from M. Polanyi's Personal Knowledge. London 1958.

(e.g. mathematics, some aspects of specific practices, etc.) which help professionals 'in communication and the cooperative accumulation of knowledge' [ibid p. 176]. The basis of their argument is essentially (but not exclusively) heideggerian in that it is based on some key concepts such as 'pre-understanding' ('pre-ontological understanding' in Heidegger's terminology) to mean that managers are not aseptically choosing among well defined alternatives, but create them out of their personal inclinations, the organizational context, and the shared background in which they operate. So that a solution is not the mere outcome of a deductive process; decision is made through the 'commitment in language of those who talk about it' [ibid p. 147]. In this respect another concept (directly taken from Heidegger) plays a crucial role, that of 'breakdown': what is taken for granted and disappears in the background of our everyday activities appears at the forefront when a problem arises. It is this 'interruption' of our customary being-in-the-world that should guide design since design is an "interpretation of breakdown and a committed attempt to anticipate future breakdowns" [ibid p. 78]. Thus language is assigned a social role in that commitments among actors (facing breakdowns) are generated through it. But language is also a 'constitutive' medium: through it we "design ourselves (and the social and technological networks in which our lives have meaning)..." [ibid p. 78] so that computers which are "designed in language... are themselves equipment for language" [ibid. p. 79].

Thus it seems that for Winograd and Flores the 'user' ought to be the 'designer'. In fact there is an interplay between actors (with their respective 'worlds') constructed by language (and by computers) when they commit themselves in solving a problem.

Ciborra's Impromptu Agenda

There are many instances that point to the influence of phenomenology, and especially to the Heideggerian version of it, on Ciborra's thinking which enabled him to view information systems not as mere objects and tools or as the outcome of abstract theories and models but as specific complex worlds [8]. This approach allowed him to take into account characteristics and traits of organizations usually neglected. It is the case of the 'red light zones' of organization examined by Ciborra [9]: the places that are barely tolerated and often overlooked by research, and that are, however, sources of new knowledge. Sources that can be leveraged just by going below the surface of the "systematic ways of organizing and executing work" and by taking into consideration "...the practice of *bricolage* and other kindred activities such as serendipity, hacking and improvisation" [10, p. 47]. In this respect, it should be noticed that Ciborra drew on *Befindlichkeit* (another pivotal concept in Heidegger's philosophy) in order to explain the phenomenon of improvisation [10] and to define the term (in his opinion abused) 'situation' [11]. Thus Heidegger grounds Ciborra's intuition that improvisation is not a mere rational and rapid problem solving. Instead, it is deeply intertwined with moods and a concept of time flow connected to people and situations rather than to clocks.

Heidegger and Some of Latour's and Ihde's Interpretations that Concern Him

Heidegger

Since the authors that have been examined in the preceding paragraph have insisted on the importance of Heidegger's 'calculative thinking' both to back their criticism of current theories and to support their findings, the following passage is important in order to avoid possible misunderstandings:

> " 'calculating' (*rechnen*) characterizes thinking within scientific projects and research. Such thinking is always calculating (*rechnen*) even when it does not deal with numbers, even when it does not use large computers. The thinking that counts is a calculating thinking (*Das rechnende Denken kalkuliert*) . . . Calculative thinking . . . never stops to meditate (*Besinnung*) . . .
>
> *There are therefore two ways of thinking both necessary and justified, even though in a different guise: calculative thinking and meditative thinking*." [12, p. 30, emphasis added][2]

In the (at times fierce) debate developed during the past century (and still ongoing) between the Continental and the Analytical Schools – in which thinkers and scholars of the opposing philosophical sides have been synthetically defined as 'hermeneutics' and 'formalists' [13] and which has been imported in the IS debate – this passage shows that Heidegger would not agree with such manichaean positions since he expressly said that there is the need of both kinds of thinking. The point he raised however is that should calculative thinking become dominant, the other kind of thinking would shrink and something human would be lost in this process. With this clarification it seems quite clear that *The Question Concerning Technology* (*QTC*) [14] – published five years before *Gelassenheit* – cannot be considered as the manifesto of the anti-formalists, a declaration of a romantic anti-technological standing.

How do Latour and Ihde Interpret Heidegger?

In his *Pandora's Hope* (but also in *We Have Never Been Modern)* Latour [15] takes some very strong standings against Heidegger:

> "[According to Heidegger] technology is unique, insuperable, omnipresent, superior, a monster born in our midst which has already devoured its unwitting midwives. But Heidegger is mistaken." [15, p. 176]
>
> ". . . it is always surprising to see how few alternatives we have to the grandiose scenography of progress. We may tell a lugubrious countertale of decay and decadence as if, at each step in the extension of science and technology, we were stepping down, away from our humanity. This is what Heidegger did . . . " [ibid, p. 211]

[2] This passage has been translated into English by the author of the paper from the Italian translation of *Gelassenheit* (1959) [12].

In the preceding paragraphs of this paper, however, all the references that have been made to Heidegger and his very work do not justify these adverse critical judgments; and this is so even if one considers only *QTC* and not also other works such as *Gelassenheit*. As it has been shown, Heidegger questions basic conceptions and proposes new perspectives. One of these is the idea that calculative thinking is dominant, and increasingly so. But it serves as a warning so that another kind of thinking which, too, characterizes man, is cultivated: the meditative, contemplative one. So that Latour's interpretation of Heidegger appears to be omissive if not misleading. At any rate, the former's concept of 'actant' seems not only to be compatible with, but even supported by the latter's overcoming of the subject–object contraposition; the following is the passage that clarifies this issue:

> "Self and world are not two beings, like subject and object or like I and thou, but self and world are the basic determination of the Dasein itself in the unity of the structure of being-in-the-world. Only because the'subject' is determined by being-in-the-world can it become, as this self, a thou for another. . . . For 'thou' means 'you who are with me in a world' " [16, pp. 297–8]

In his *Technology and the Lifeworld* [17] Ihde's interpretation is more melange, but still debatable. In fact, he tends to read QCT in an ecological perspective [ibid p. 173]: once again the implicit judgement is that Heidegger considers modern technology negatively, which was not the point that the philosopher was trying to make. Ihde does not agree with Heidegger on the possibility of an upcoming 'sheer world of calculative thought' because '[t]here will be diversity, even enhanced diversity, within the ensemble of technologies and their multiple ambiguities, in the near future'. [ibid p. 159]. However, further on in his book he slightly modifies his view:

> "... Heidegger's characterization of the age as one of 'calculative reason' is partially correct ... Most of the practitioners of technical processes are themselves quantitative thinkers. Situations are posed and perceived as 'problems' which imply 'solutions', the means of which are 'rational' (calculative) processes." [ibid p. 177]

A further point of differentiation from Heidegger is on the 'exit' from the calculative world: "I reject the notion made popular by Heidegger that 'only a god can save us.' " [ibid p. 163]. Ihde in fact believes that something can be done: conservationists are right in trying to mitigate the adverse impacts of certain types of technologies. In this respect he acknowledges Heidegger of having questioned some 'dominant cultural and religious beliefs' [ibid p. 198]. Thus in spite of the differences with Heidegger, Ihde is not at odds with the principles that should drive the preparation of an 'IS management agenda', as outlined in the next paragraph.

Outcomes

Within the interplay of IS – to be considered as both a reference discipline and a referring one [1] – with philosophy, the use of some changes and focal points brought about by Heidegger (and employed by the above cited authors in order to

support their criticism of other approaches or to ground their findings) seems to have shown fruitful results. In spite of the amplitude of the interactions between Heidegger and the scholars examined (which go far beyond the examples that have been cited here) some common grounds have been found in the questions they addressed which are relevant for IS design and implementation: the importance of 'everyday life' in organizations and the positive role played by 'breakdowns', the centrality of the human being considered as endowed with moods and not only with (bounded) rationality, the importance of 'engagement' in being-in-an-organization (*versus* 'reflectivity'). Probably then, there is the need for a renewed attention to the 'human resources' question for the development of a different sensitivity with respect to participation in the design/adoption processes of IS systems so that a better combination between commitments, communication, and the use of jargons can be achieved.

At the 'macro' level since modern technology has an enframing effect on society (the diffusion of calculative thinking, bearing in mind the points of attention raised by Ihde) a 'policy' that could promote the survival of 'meditative thinking' within the IS field should be characterized by 'decentralization', so that 'everyday life' contacts, exchanges, commitments between people and the construction of 'local' and 'transient' communities is encouraged.

References

1. Baskerville, R.L. and Myers, M.D. (2002) Information Systems as a Reference Discipline. *MIS Quarterly* Vol. 26, No. 1, pp. 1–14
2. Introna, L.D. and Ilharco, F.M. (2004) Phenomenology, Screens and the World: A journey with Husserl and Heidegger into Phenomenology. In Mingers, J., Willcocks, L. (eds) *Social Theory and Philosophy for Information Systems*. Chichester: Wiley
3. Milchman, A. and Rosenberg, A. (2003) Toward a Foucault/Heidegger *Auseinandersetzung*. In Milchman A., Rosenberg A.(eds) *Foucault and Heidegger*. Minneapolis: University of Minnesota Press
4. Dreyfus, H.L. (1991) *Being-in-the-World*. Cambridge UK: The MIT Press
5. Dreyfus, H.L. (1992) *What Computers* Still *Can't Do*. Cambridge Mass.: The MIT Press
6. Dreyfus, H.L. (2001) *On the Internet*. London: Routledge.
7. Winograd, T. and Flores, F. (1986) *Understanding Computers and Cognition: A New Foundation for Design*. Norwood: Ablex.
8. Introna, L.D. (2005) Claudio Ciborra's way of being: Authenticity and the world of information systems. *EJIS*, Vol. 15, No. 5
9. Whitley, E.A. (2005) Visiting the Red Light Zones with Claudio. *EJIS*, Vol. 14, No. 5, pp. 477–479
10. Ciborra, C. (2002) *The Labyrinths of Information*. Oxford: Oxford University Press
11. Ciborra, C. (2006) The mind or the heart? It depends on the (definition of) situation. *Journal of Information Technology*, Vol 21, No. 3, pp. 129–139
12. Heidegger, M. (1989) *Gelassenheit*, Pfullingen: Neske. 1959. Italian translation: *L'abbandono*. Genova: Melangolo, IL
13. West, D. (1997) Hermeneutic Computer Science. *Communications of the ACM*. Vol. 40, No. 4, pp. 115–116

14. Heidegger, M. (1993) The Question Concerning Technology, in *Basic Writings*, London: Routledge
15. Latour, B. (1999) *Pandora's Hope*. London: Harvard University Press
16. Heidegger, M. (1982) *The Basic Problems of Phenomenology*, Bloomington: Indiana University Press
17. Ihde, D. (1990) *Technology and the Lifeworld. From Garden to Earth*. Bloomington: Indiana University Press

E-Government Performance: An Interdisciplinary Evaluation Key

M. Sorrentino[1] **and M. De Marco**[2]

Abstract What do we mean by implementation, defined as the conversion into concrete actions of an e-government programme? Is it possible to assess the results in terms of the capacity to offer solutions to problems of public import? Literature suggests the need to evaluate the outputs, outcomes and impacts of public programmes. Nevertheless, these principles remain particularly complex to put into practice today. The paper sustains that an organisationally rooted approach – especially studies that place the emphasis on processes of action and decision – can help to widen our lens and further our knowledge on how to evaluate a complex social phenomenon such as e-government.

Introduction

What do we mean by implementation, defined as the conversion into concrete actions of a plan to develop e-government at the national or local level? Is it possible to "explain" and evaluate the results of these complex projects and programmes (according to the OECD [1]: "e-government is the use of information and communication technologies, and particularly the Internet, as a tool to achieve better government") in relation to their capacity to offer solutions to problems of public import?

Academic literature, e.g. the seminal studies of Pressman and Wildavsky [2], suggests the need to evaluate the outputs, outcomes and impacts of public programmes. Our analysis identifies e-government outputs as those "products" generated by the public administration (PA) – e.g., services, certificates, permits etc. On the other hand, e-government outcomes are the short- or medium-term effects that emerge

[1]Università degli Studi di Milano Dipartimento di Scienze Economiche, Aziendali e Statistiche, Milano, Italy, maddalena.sorrentino@unimi.it
[2]Università Cattolica del Sacro Cuore, Dipartimento di Scienze dell'Economia e della Gestione Aziendale, Milano, Italy, marco.demarco@unicatt.it

when the output reaches its target – citizens, businesses, other PA. Ultimately, the impacts refer to the underlying problem addressed by the programme. Among the many examples of this latter is the lessening of social unrest, greater democratic participation, the narrowing of the digital divide, etc. Compared to the effects mentioned earlier, the impacts are more ambitious as these "force one to ask what is the final significance of what we are doing" ([3], p. 163).

In this paper we sustain that an organisationally rooted approach and, in particular, contributions from studies that place the emphasis on processes of action and decision – can help to widen our lens and further our knowledge on the theme of post-implementation e-government evaluation. Naturally, this paper neither attempts to solve nor address the issue of the best theory, model or set of indicators to represent the phenomena in question. Indeed, we believe that the knowledge of the assumptions underlying the diverse proposals is an essential condition for laying the foundations of a debate that is truly interdisciplinary and that, in time, this will help enrich the implementation research agenda.

Therefore the pages following propose to: (a) explain why the theoretical frameworks commonly used do not adequately represent the phenomena related to e-government implementation; and (b) take a first step towards an alternative interpretive proposal that incorporates and adopts the contributions from organisation science. The remainder of the paper is organised as follows. Section "Unravelling the e-Government Evaluation Puzzle: Summary of the Debate" briefly reviews the literature on the theme, first from the ICT and then the Policy Studies viewpoint. Section "Commenting the Two Perspectives" comments the key assumptions underpinning these approaches. Section "Organisational Action and Implementation Evaluation" proposes the Theory of Organisational Action as a meeting place for studying e-government implementation. The final considerations in section "Implications and Conclusions" summarise our findings.

Unravelling the e-Government Evaluation Puzzle: Summary of the Debate

Whoever ventures into the broader terrain of e-government performance evaluation – in this paper we use the words "performance" and "results" to mean the whole of the outputs, outcomes and impacts – finds his/herself facing a variegated landscape through which it is hard to chart a path, due to the diverse features, mechanisms and stakeholders (institutional and social) involved at different levels in the implementation process.

It is never banal to provide a direct reply to questions such as: "In what measure has the development of single points of access to public services increased the efficiency and transparency of the agencies?" "Is it true that the smart card distributed to millions of citizens has improved regional health services?". It is also difficult to think in terms of impact. The impact focuses on all the potential effects – tangible and symbolic – that the various phases of the public policy process can

trigger in other public policy sectors and in the political system. A recent study [4] has shown, for example, that it is almost impossible to assess the impacts of e-government on the social objectives behind its development, namely the improvement of citizens' trust.

Documented e-government experiences, both academic and professional, reveal different returns, on the one hand, for citizens and businesses and, on the other, for government/public authorities [5, 6]. Therefore, it should come as no surprise that when evaluating implementation, many public agencies focus on the less problematic aspects, on "delivery benchmarking" (i.e., progress in establishing electronic channels, their content and level of acceptance), rather than on the overall returns. In other cases, data are presented as indicators of success, when, in reality, these simply document what has been done (that is, the outputs achieved) in the reference period. The success of an e-government programme for politicians often coincides with the assets or the financial and human resources that they can reroute to a specific administration sector, preferably located in their constituency. The criteria used to evaluate implementation are thus strictly tied to the perspective that inspires them. In this sense, the criteria are inevitably limited.

For the purpose of reconstructing the fundamental threads of the current debate, the following sections outline the literature that has addressed the implementation theme and its evaluation. Of course, not all published research contributions are reviewed here. In this paper we have chosen – from the many alternatives (e.g. economics, management studies, sociology, law, psychology, etc.) – to favour only two perspectives: ICT studies and Policy studies.

ICT Studies. Since the inception of e-government, the technocratic perspective has been the best known interpretive key adopted by many academics and public authorities. In this sense, e-government compares with historical examples of technological change [7]. Computer Science and Information Systems (IS) disciplines offer well-established prescriptions and recommendations for implementing projects, for analysing the requirements, for developing and testing systems and incorporating these into the existing IS infrastructures, for evaluating performance, etc. Such studies employ hypothetical-deductive methods, attempting to explain and predict events in the social world by matching regularities and searching for causal relationships ([8], p. 75). The rational evaluation approach boasts the greatest level of diffusion and therefore is a consistent factor wherever the success of information systems or public programmes needs to be evaluated or measured (ibidem).

The social studies of IT [9] highlight the problematic aspects of the rational model. For example, the critics underscore how the results of projects are anything but a given and that these are influenced also by factors of a social and behavioural nature. Moreover, projects at the micro-level of a public organisation and the desirable effects on the macro-conditions of a country is poorly understood. Those who share this research view – in agreement with [10] and with [11] – sustain that the models inspired by the rational view are over-weighted on the "tools" (better tools) side to the detriment of the "purposes" of the evaluation (what to measure and why).

Policy Studies. In general terms, policy studies address the evaluation of public policies with an approach that – simplified to the max – reflects the classic models of

the top-down and bottom-up type. According to the former view (which has dominated the first phase of implementation research), the analysis focuses on the relationship between goals and results and on the congruency between the methods of implementation called for by the programme and those concretely put in place: conformance ensures performance [12]. The aim of the researcher is to evaluate possible gaps between the goals of the programmes and the effects actually produced and – on the evidence of such gaps – attempt to identify the cause of the lack of success.

The critics of the top-down approach point out that proposals which adopt the assumptions of the rational model all share the same flaws: technical unreliability, excessive consideration of the quantitative aspects combined with "easy" measurements and the undervaluation of the indirect costs (i.e.. costs that are the result of the "inconveniences" suffered by both companies and citizens to adapt to the new provisions, gathering information and physically going to the offices in question) ([3], p. 174).

An alternative approach – which considers the so-called "implementation deficit" a physiological rather than a pathological aspect – adopts a bottom-up orientation. Evaluating implementation, therefore, is no longer the measuring of compliance with formal requirements. Instead, the interest shifts directly to the concrete results and only then traces the factors that connect each result. The reconstruction of the policy lifecycle is done in reverse, a model that is known as backward mapping. Thus, it is possible to evaluate performance also from the viewpoint of the peripheral implementers (known as the street-level bureaucrats), rather than confining its scope to solely to the policymakers' viewpoint.

Commenting the Two Perspectives

That brief review enables us to propose two generalisations. The first is that, contrary to a widespread belief that implementation can be reduced to merely an activity of technical execution, implementation (but, above all, its evaluation) is strongly characterised by a "political" viewpoint. As ([12], p. 391) suggest, questions of "what", "how" and "when" to evaluate tend to determine the final result of any evaluation effort.

The second generalisation, which is linked to the first, is that the distinction between the formulation and activation phases in a public program is certainly very useful in analytical terms, but also fairly unrealistic. There is a continuum between the moment of formulation and the action aimed at the realisation of the interventions; in turn, implementation leads to ongoing reformulations and checks during the work in progress. These moments form an organic whole in which the implementation process is difficult to distinguish from the context: implementation "is" evolution [13].

Returning to the object of our reflection, therefore, we can say that what an e-government initiative effectively consists of – what its real effects are and, especially, its consequences in terms of resource allocation and benefits for the various

stakeholders – is determined during its implementation. This consideration leads to the need – from the methodological viewpoint – to approach the evaluation not by starting with the effects ensuing from the coming on stream of the new digital platform or online services, but by taking into account the entire *process* connected to that particular public initiative.

Organisational Action and Implementation Evaluation

In order to better clarify the role and importance of the organisational theory in evaluating e-government implementation we will use a perspective [14, 15] in which: (a) the organisation is meant as a *process* of actions and decisions; (b) rational action is meant in an intentional and limited sense; and (c) the actors are an integral part of the process (by which we mean that the process overrides any separation between individual and organisation).

The above principles are part of a conceptual framework known as the Theory of Organisational Action (TOA). Starting with the research of some classic authors, [16–19], Maggi has identified a common thread on which he has built his proposal. The word 'action' indicates the connection of the behaviour of a human agent to a subjective meaning. Therefore, a concept of organisation in terms of actions and decisions is "mindful of the individuals and the *relational structures* that these produce and *reproduce* unceasingly" ([20], p. 220).

The few elements cited already enable us to intuit that we are dealing with a theoretical framework that leads to a different view of things. On the one side, we have perspectives that see the organisation as a concrete reality in which action is *also* a factor, while on the other, we have the perspective in which the organisation *is* action that develops over time. According to TOA, organisational action is a particular form of rational action, since, by definition, it is an action that has a tendency to shape the means to the ends. Organisational rationality is rooted in both technology and task environment ([18], p. 39). The technology is meant both as technical knowledge and as a structural component of the organisational processes. In line with the greater or lesser capacity to achieve the expected results, more or less adequate technologies will be deployed.

If we assume that e-government is a bounded rational organisational process, the possibility of maximising the results is excluded a priori because it would be like affirming that the relationship between the means, i.e., the technical knowledge, the software applications, the operating procedures and the ICT platforms, and the ends, i.e., the problem underlying the public programme, is optimal. Nevertheless, it is possible to direct the e-government actions and decisions of the PA towards *satisfactory* results for the various categories of subjects, the needs and opinions of whom – we reiterate – can significantly differ: "where social referents are involved, differences of opinion are possible and, moreover, the referent may be rather unstable" ([18], p. 87). Then the road to implementation can be continually modified based on new knowledge, new values and preferences. The whole of which fits into a framework of possibilities that are neither optimal nor predictable.

In essence, evaluating the results of an e-government programme means connecting the "context and content of what is implemented" [2]. The performance analysis – carried out on the overall or on a specific phase of an e-government initiative – is an integral part of an organisational process that has its own specificity. In line with the goals of the evaluation, TOA enables us to explain the meaning for the chosen actions (not only of the technical but also the institutional and structural type) in relation to the reciprocal conditions of variability.

Implications and Conclusions

This article suggests the use of an interpretive key that intrinsically straddles more than one discipline, that draws on classic authors of organisation science, whose contributions to the field were conceived to apply broadly across all types of organisation settings. The concept of intentional and bounded rationality, which is a foundation of TOA, comprises closely related economic, sociological and psychological factors. Therefore, it can be used as a starting point for a dialogue between the different disciplinary fields that address e-government.

From the concrete viewpoint, the perspective described herein can provide public managers and evaluators with a useful toolkit. The *interpretation* of the results of an e-government programme over a specific time horizon takes as "given" both the complexity of the situation and the different and changing experiences of the stakeholders. The outcome of the interpretation – guided by the logic of the TOA (intentional and bounded rationality) – is the evaluation of the *congruency* between the diverse components of the organisational processes analysed. This perspective can help, for example, to incorporate the evaluation-related needs as early as the planning and design phase of the e-government project or programme. The proposed framework also suggests that because e-government requires the joint use of many lines of intervention, the typical measuring of outputs or financial effects should necessarily be integrated with other indicators more oriented to the analysis of the social impacts of the PA action.

As a preliminary discussion, this article refers to only two of the disciplinary fields that have addressed the evaluation theme, that is ICT and policy studies. For reasons of space, we have not considered another equally relevant perspective for the public sector, i.e., economic theory. Future research efforts must also investigate this field.

References

1. OECD (2004). *The e-Government Imperative*, OECD, Paris
2. Pressman, J. and Wildavsky, A. (1973). *Implementation*, University of California Press, Berkeley (Third ed.)
3. Regonini, G. (2001). *Capire le politiche pubbliche*, il Mulino, Bologna (in Italian)

4. Avgerou, A., Ciborra, C., Cordella, A., Kallinikos, J., and Longshore, Smith M. (2006). E-Government and trust in the state: Lessons from electronic tax systems in Chile and Brazil, *LSE Working Paper Series* No. 146, May
5. Capgemini, T.N.O. (2004). *Does e-government pay off*? EUREXEMP-Final Report, November
6. Rebora, G. (1999). *La valutazione dei risultati nelle amministrazioni pubbliche*, Guerini e Associati, Milano (in Italian)
7. West, D.M. (2005). *Digital Government*, Princeton University Press, Princeton
8. Symons, V. and Walsham, G. (1991). The evaluation of information systems: A critique, in R. Veryard *The Economics of Information Systems and Software*, Butterworth-Heinemann, Oxford, 71–88
9. Avgerou, A., Ciborra, C., and Land, F. (Eds) (2004). *The Social Study of Information and communication technology*, Oxford University Press, Oxford
10. Smithson, S. and Hirschheim, R. (1998). Analysing information systems evaluation: Another look at an old problem, *European Journal of Information Systems* (7) 158–174
11. Wilson, M. and Howcroft, D. (2000). The politics of IS evaluation: A social shaping perspective, *Proceedings of 21st ICIS*, Brisbane, Queensland, Australia, 94–103
12. Barrett, S. and Fudge, C. (Eds) (1981). *Policy and Action. Essays on Implementation of Public Policy*, Methuen, London
13. Majone, G. and Wildawsky, A. (1978). Implementation as Evolution, *Policy Studies Review Annual*, vol. 2, 103–117
14. Maggi, B. (1990). *Razionalità e benessere. Studio interdisciplinare dell'organizzazione*, Etaslibri, Milano (Third ed.) (in Italian)
15. Maggi, B. (2003). *De l'agir organisationnel. Un point de vue sur le travail, le bien-être, l'apprentissage*, Octarès, Toulouse (in French)
16. Barnard, C. (1938). *The Functions of the Executive*, Harvard University Press, Cambridge
17. Simon, H.E. (1947). *Administrative Behaviour*, Macmillan, New York
18. Thompson, J.D. (1967). *Organizations in Action*, McGraw Hill, New York
19. Giddens, A. (1984). *The constitution of society*, Polity Press, Cambridge
20. Maggi, B. and Albano, R. (1997). La Teoria dell'Azione Organizzativa, in G. Costa e R.C.D. Nacamulli, *Manuale di Organizzazione Aziendale*, Utet, Torino, Vol. 1 (Second ed.), 220–249 (in Italian)

The Tacking Knowledge Strategy Claudio Ciborra, Konrad Lorenz and the Ecology of Information Systems

F. Ricciardi

Abstract This work focuses on an issue that Lorenz identifies as fundamental among human cognitive strategies: what we could call *the tacking knowledge strategy*.

Knowledge doesn't go on straight: like a sailing boat coursing against the wind, it must turn and turn again, frequently changing its approaches. This strategy implies that rationality is not, according to Lorenz, the apex and the fulfilment of a linear improving process in biology of knowledge; it is a phase and an instrument, transitory as all the others are. Studying the swinging strategies of human knowledge, in effects, Lorenz gets to several issues which seem peculiarly useful to cope with Ciborra's concerns about the complex, unforeseeable and social nature of Information Systems.

Introduction

Claudio Ciborra opposes, within IS discipline, a phenomenologic approach to what he calls the positivistic-cartesian approach [1]. Science-based approaches are unable, according to him, to take into account the importance of moods, improvisation and social relationships in innovating and problem-solving activities of individuals and organizations [2–4].

Nevertheless, this frontal opposing between "positivistic" and "humanistic" approaches in IS disciplines can have unpleasant consequences. The aim of this paper, then, is to give some hints to overcome this opposition, referring to the studies about the *natural history of knowledge*, made by the father of ethology, Konrad Lorenz.

According to Lorenz, in fact, life, even in its simplest forms, is a terrific structure for grasping and accumulating knowledge [5]. Knowledge, in other words, is the very strategy of life itself. Human beings and their artifacts (IS included) can be usefully studied from this point of view.

Università Cattolica del Sacro Cuore, Brescia, Italy, francesca.ricciardi@unicatt.it

This approach could be useful to understand the innovation of IS as a part of a living system's evolution: the knowledge system of human beings, in fact, in its strongly cultural nature, has got precise innate strategies and ways of acting, which it would be counter-productive not to take into consideration [6].

There are, then, many findings and methodologies, within Lorenz's work, that may be interesting to build and strengthen an ecological and anthropological view of IS. In this scenery, themes regarding models, plans, procedures and programs in organizations (and particularly their layering, selectivity, fragmentation, recombining, innovating, flexibility and effectiveness) can be seen from an evolutionary point of view, taking into consideration the importance of time factor and the innate learning and problem-solving strategies of our species.

Long-Term and Short-Term Knowledge

According to Lorenz, life has different strategies to cope with the challenges of the environment: in extreme synthesis, long-term knowledge for long-term problems, and short-term knowledge for short-term problems [5, 7].

Long-term problems consist in recurrent or steady situations or events: they're challenges that tend to occur again and again with similar characteristics.

To face these challenges, the most effective solving sequences are selected during very long periods of casual trials. As these sequences work automatically, they let living beings save time and energy; moreover, like every program or procedure, they treasure (even if in an unaware and implicit form) a deep knowledge of the challenge's main characteristics. E.g., we have sequences in the DNA that fix haemoglobin dosage in blood; these sequences are consequences of (and then "contain" information about) the rate of oxygen in the air, the average oxygen needs in muscles, the problems of blood viscosity, and so on. In spite of the rigidity of these programs, innovation is possible: e.g., populations that evolved in high mountains tend to have higher ranges of haemoglobin, to cope with the lack of oxygen in the air. *But* innovation is impossible inside a single individual: it occurs by natural selection, through the death of the unfit organisms [5].

This strategy has a sort of cruel efficiency, but it can't store impromptu information, so it can't manage extemporary challenges (e.g., the sudden presence of dangerous zones in a certain territory). That's why *short-term knowledge* goes into action: it is a different strategy, based on the capability of individual *learning*. This strategy uses others devices of storing, different from the DNA: e.g., the immune system, and the nervous system above all.

DNA, on the other hand, *addresses* the nervous (or immune) system's activities of identifying events or situations, reacting, learning: e.g., a goose can identify the shape of a predatory bird in the sky, because the *pattern* of "eagle-like," although unaware, is available, embedded in the goose's innate cognitive equipment. There is

an extraordinary amount of knowledge, that animals treasure in their nervous system since they're born, by direct order of the DNA: this knowledge, that often acts as an "innate instructor," is the "a priori basis for every further buildup of information"[1] [5].

In other words, the price of (successful) flexibility is surprisingly an increase, in the deeper layers, of (well tested) rigidity.

Evolving Knowledge: The Spiral Paths of Learning

Learning behaviors in living beings are triggered by powerful emotional thrusts. In other words, in order to trigger trials, curiosity, training, and so on, the organism uses the same mechanisms of desire/satisfaction that all the animals have for food and sex, just addressing them to *learning in itself* [5, 8].

Moreover, emotions and other innate mechanisms not only trigger learning activities: they *address* and *manage* them. E.g., little children tend to listen to parents (or caregivers), and to follow their advices; but they're often scared if they're asked by unknown adult people, and they run to hide not to obey their requests. In other words, we have innate instructors that not only provide many *a priori* patterns to build further knowledge, but also tell us (often using the powerful language of feelings and moods) *what, how, from whom* we should learn.

Another example: a cat locked in a cage makes "reasonable" attempts to escape: it scrapes the walls, it tries to squeeze its nose among bars; the cat does not try to escape by licking its own foot, nor by closing an eye [5]. A sort of "work hypothesis" is available for the cat when trying to spot a solution; many "work hypothesis" of this kind are hereditary, and then put in the brain by the genome itself. So, the innate instructor will force the animal to go on trying, and will also address its efforts towards more probably successful attempts. If the cat spots the solution (e.g., it finds a button that opens the cage), the learning process is complete: the next time, the cat will open the cage immediately.

Lorenz [5–8] identifies several sorts of learning programs, continuously interacting to build several layers of knowledge that flow in parallel rows, like freeway lanes, from the more slowly-changing ones to the more rapidly evolving. In extreme synthesis, here they are:

(a) *Pattern matching* (e.g., the goose identifies the danger when seeing an eagle-like shape in the sky, see above)
(b) *Imprinting* (e.g., a goose identifies as "mother" the first moving object it meets)
(c) *Trials/errors* (e.g., the cat in the cage, see above)

[1] Lorenz often uses the expression "a priori", to indicate *innate knowledge*, explicitly referring to Kant.

(d) *Training* (e.g., puppies that "tailor," by playing, their motor sequences)
(e) *Imitation* (e.g., apes imitate their mates, for "emotional tuning" and communication)
(f) *Exploration/curiosity* (e.g., rats pass through all the shelters of their environment, even if they don't need to find a den at the moment: "just to know")
(g) *Self-exploration* (training + imitation + curiosity, addressed to one's own body or capabilities)
(h) *Imaginary trials* (e.g., an ape sees a banana hanging from the ceiling, too high to be reached with a jump; the ape stops before the dilemma, and thinks before acting)
(i) *Symbolic linking* (e.g., a dog learns the meaning of the word "biscuit")
(j) *Imaginary exploration* (exploring and manipulating symbols instead of things, even without an immediate need or dilemma)

All these activities can help us to find new solutions for extemporary problems (e.g., the ape drags a box under the banana, climbs it and reaches the fruit); but the learning process doesn't end with these *impromptu* findings. In fact, animals *strongly tend to transform good solutions into routine*.

When a learning behavior leads to success (e.g., the cat finds the button that opens the cage), the new procedure developed in this way tend to supersede the innate instructor's flexibility, and to become a habit (when put in a similar cage, but with a different system of escaping, for example a door to be pulled by nails, the cat will disregard all the other attempts and will go on uselessly pushing the "old" button, and then will quit trying to escape; but a "new" cat, not affected by the habit, will probably find the solution). In other words, rewarded success fastens the achievement of similar successes, but decreases the capability of learning from one's own failures [5, 9]. Successfully learning is, then, a double-blade weapon, also for human beings.

Knowledge strategies of superior animals, thus, are based on a recurring process, that alternates thrusts to find new solutions (through learning activities) and thrusts to build (or obey to) long-lasting routines, aimed to acquire long-term, economic solutions.

As a result of this dynamic tension (as long as it works well), knowledge widens and evolves, like a spiral, every time the learning cycle is fulfilled: from innate patterns and thrusts towards learning activities; from learning activities towards new findings; and from new findings to new patterns and thrusts that will influence any further learning, and so on.

The different forms of learning listed above, then, lead to results and findings that tend to flow into routine. The spiral paths of learning give rise to [5, 7]: *habits* (from trials/errors learning above all); *traditions* (from imitation above all); *smoothness* in certain sequences (from training above all); *maps* (from exploration above all); *languages* (from symbolic linking above all); and *aware, formalized analysis/modeling/hypothesis/plans/procedures* (from imaginary exploration above all).

The Tacking Knowledge Strategy[2]: The Importance of the Emotional Sail

In human species, according to Lorenz [5, 10], two fundamental moods exist, in order to learn and to face problems: the one we could synthesize with the adjective "conforming," and the opposite one, that Lorenz often defines "rascally," mischievous, disobedient.

When a being is in the "conforming" mood, all his/her activities tend to repeat and fine-tune pattern and procedures acquired in the past. When a being, on the contrary, is in the "rascally" mood, all his/her cognitive activities are aimed to corrode, to deny, to overthrow patterns and habits of the social group he/she belongs to.

These two moods are both important, Lorenz says, to guarantee the capability of learning and problem-solving in a species, like ours, that widely depends on cultural evolution. In fact, the conforming mood has the aim to hand down, and to fine-tune, any knowledge that has already demonstrated itself effective to face and to solve previous problems; the rascally mood, instead, works to avoid that traditions and habits change into "cultural straightjackets," and to provide alternatives to exploit when (sooner or later, it happens) new problems occur, that pre-existing patterns and procedures will be unable to face.

Thus, there is no hierarchical relationship to be established, according to Lorenz, between these two opposite moods. Human knowledge needs them both, because it can evolve only by zigzagging, approaching its destination by alternating turns: like a sailing boat coursing against the wind, on a bowline.

Lorenz deeply studies the innate basis of these two cognitive attitudes, and discovers that the conforming moods are linked to belonging feelings, hate for "the different ones," optimism and confidence; rascally moods, on the other hand, are linked to an insolent, curious individualism, to a greedy love for what's new and different, and to a watchful, alarmed pessimism.

This is, of course, a very refined cognitive strategy, and this "tacking moody mechanism" of the mind can be, just because of its complexity, quite fragile and exposed to several pathology [5, 9, 10]: just to make some examples, Lorenz mentions racism (due to excessive conforming moods) and depression (that occurs when a person remains blocked in the destructive pessimism of the rascally mood).

Lorenz's thought about these issues, that he developed from the 1940s of the twentieth century, comes to be peculiarly near to Ciborra's concerns [1, 11, 12] about the assumption that reality can be totally and finally controlled by engineered procedures and technology, which are, on the contrary, as Lorenz says, just a phase of an endless learning process.

[2] "Tacking knowledge strategy" is not an expression of Lorenz's, but I hope it can effectively synthesize his vast studies on the matter.

Concluding Remarks and Hints for Further Researches

Ciborra [1] claims that his own researches and findings "fly in the face" of natural science paradigm, which, according to him, is dominating in IS disciplines. Yet, just a (great) natural scientist like Lorenz can give some important confirmations and tools about some issues of Ciborra's:

(a) Rational planning and implementation activities, by themselves, are unable to innovate (i.e., establish new effective solutions to the emerging problems). Innovation, in fact, *occurs during learning activities*. Learning has several ways, but it can be really innovative only when it takes place in the "rascally" mood. Planning, implementation, procedures etc. are a following phase and have another aim: to make the beneficent effects of *previous* learning (and then of innovation) available, at the largest scale (and, afterwards, to provide a new "a priori" basis for further buildup of knowledge) [see 1, 13].
(b) A living being that does not give space to learning, with all he wastes and risks connected with learning, is condemned to the only other evolving system existing in nature: selection, and death of the unfit individuals. This is valid also for organizations [14, 15].
(c) In Lorenz's view, improvisation and creativity can be seen as a very rapid short-circuit between new learning and previous knowledge, i.e., between (creative) disobedience and (competent) conformism: a peculiar strategy of our species, without which we could not survive the challenges of the environment [3, 13, 16, 17].

Lorenz's issues, then, seen from the IS disciplines point of view, confirm some of Ciborra's claims: it's impossible to innovate systems in organizations without involving "messy" processes like trial/error activities (Ciborra would say: tinkering) or curiosity/exploration (Ciborra would say: serendipity). Rational planning is just a phase of the knowledge spiral, and besides it is not the phase in which innovation takes place. But Lorenz [5], with his spiral, tacking model, stresses an aspect that Ciborra tends not to take into consideration: also rational planning, design, procedures etc. can provide the raw materials to build (through comparing, improvisation, rebellion) further, unpredictable learning.

Further researches would be advisable to deepen these issues, and to improve awareness of the real factors that influence innovation in organizations.

References

1. Ciborra, C. (2002). *The Labyrinths of Information*. Oxford: Oxford University Press
2. Ciborra, C. (1998). Crisis and foundations: An inquiry into the nature and limits of models and methods in the information systems discipline. *Journal of Strategic Information Systems* 7, 5–16
3. Ciborra, C. (2001). In the Mood for Knowledge. A New Study of Improvisation, Working Paper Series, London School of Economics and Political Science, London, UK

4. Ciborra, C. and Willcocks, L. (2006). The mind or the heart? It depends on the (definition of) situation. *Journal of Information Technology* 21, 129–139
5. Lorenz, K. (1973). *Behind the Mirror. A Search for a Natural History of Human Knowledge*. Harcourt Brace, New York
6. Lorenz, K. (1996). Innate bases of learning. In *Learning as Self-Organization*, Pribram, K. H., King, J. (eds). Mahwah, New Jersey: Lawrence ErlbaumAssociates
7. Lorenz, K. (1995). *The Natural Science of the Human Species: An Introduction to Comparative Behavioral Research – The Russian Manuscript* (1944–1948). Cumberland, Rhode Island: MIT
8. Lorenz, K. (1966). *On Aggression*. New York: Harcourt, Brace and World
9. Lorenz, K. (1974). *Civilized Man's Eight Deadly Sins*. New York: Harcourt Brace
10. Lorenz, K. (1983). *The Waning of Humaneness*. Boston: Little Brown
11. Ciborra, C. (1996). The platform organization: Recombining strategies, structures, and surprises. *Organization Science* 7(2), 103–118
12. Ciborra, C. and Hanseth, O. (1998). From tool to Gestell – Agendas for managing the information infrastructure. *Information Technology & People* 11(4), 305–327
13. Ciborra, C. and Lanzara, G.F. (1994). Formative contexts and information technology: Understanding the dynamics of innovation in organizations. *Journal of Accounting, Management and Information Technology* 4(2), 61–86
14. Ciborra, C. and Andreu, R. (1996). Organisational learning and core capabilities development: The role of ICT. *Strategic Information Systems* 5, 111–127
15. Ciborra, C. and Andreu, R. (2002). Knowledge across boundaries. In *The Strategic Management of Intellectual Capital*. Choo, C.W., Bontis, N. (eds). Oxford: Oxford University Press
16. Ciborra, C. (1999). Notes on improvisation and time in organizations. *Journal of Accounting, Management and Information Technology* 9(2), 77–94
17. Ciborra, C. and Lanzara, G.F. (1999). A theory of information systems based on improvisation. In *Rethinking Management Information Systems*. Currie, W.L. and Galliers, B. (eds). Oxford: Oxford University Press

Part II
Is Development and Design Methodologies

C. Batini

Technological infrastructures for IS development and design have evolved in the last 30 years from monolithic architectures, to distributed, cooperative, web based, service based, P2P architectures. At the same time, IS are now characterized by widespread applications in the life of persons and communities, and in the evolution of businesses. The same concept of information has evolved, from structured data, to semi-structured data, documents, images, sounds, smells. Methodologies for IS development and design (ISDD) have correspondingly evolved, and, besides ICT aspects, different issues and research areas are considered, from social, to economic, juridical, and organizational issues. Furthermore, it is now clear that methodologies have to take into account users, services, processes, organizations, and ICT technologies; each one of the above contexts has to be characterized in terms of goals and relevant perceived/measurable qualities. Finally, such a wide set of topics cannot be managed without new tools that support the designer in relevant decisions. Topics include (but are not limited to): Social, economic, organizational, juridical issues vs. technological issues in ISDD methodologies; Multidisciplinary ISDD; Economy of information and ISDD; Information value/constellation chain and ISDD; Quality driven ISDD; Cost benefit analysis in ISDD; ISDD for specific domains: e-government, B2B, B2C, others; Knowledge management in ISDD; Security in ISDD; Legacy management in ISDD; Tools for ISDD.

Università degli Studi di Milano Bicocca, Milano, Italy, batini@disco.unimib.it

Loitering with Intent: Dealing with Human-Intensive Systems

P. M. Bednar[1] **and C. Welch**[2]

Abstract This paper discusses the professional roles of information systems analysts and users, focusing on a perspective of human intensive, rather than software intensive information systems. The concept of 'meaningful use' is discussed in relation to measures of success/failure in IS development. The authors consider how a number of different aspects of reductionism may distort analyses, so that processes of inquiry cannot support organizational actors to explore and shape their requirements in relation to meaningful use. Approaches which attempt to simplify complex problem spaces, to render them more susceptible to 'solution' are problematized. Alternative perspectives which attempt a systematic, holistic complexification, by supporting contextual dependencies to emerge, are advocated as a way forward.

Introduction

There is a strand of IS discourse that focuses on *software intensive systems*, [1]. While the concepts of *human activity system* and *hardware system* are both acknowledged, the main focus of attention is put on software intensive systems. Our intention is to shift the focus onto arguments following a human centered tradition in IS, and to discuss analysis and design in a context of *human intensive systems*. Here we believe it is important to consider whole work systems, including sociological and philosophical perspectives, without losing sight of their relationship to concrete IT artifact design. This is demonstrated by work of e.g. [2] on data modeling, [3] discussion of intelligent machines, and [4] on object oriented design. When viewing IS as human intensive, we need to give careful consideration to human sense-making

[1]Lund University, Department of Informatics, Sweden; University of Portsmouth, School of Computing, Hampshire, UK, peter.bednar@ics.lu.se
[2]University of Portsmouth, Department of Strategy and Business Systems, Hampshire, UK, christine.welch@port.ac.uk

processes [5–7]. This includes giving attention to aspects of sociological and philosophical complexity [8–10]. In this paper, we explore problems of reductionism that can arise from different traditions of inquiry, and present a possible approach to dealing with them in which professional analysts take on an on-going role of 'loitering with intent' to support people in creating their own systems. Commonly, developers will ask 'Who will be using this system? What do those people expect that the system will be able to do, and how do they expect it will do this?' [11, 12]. However, we believe that these questions alone will not explore what is 'meaningful use' from the point of view of the individuals using the system. For this, an inquiry is needed which goes on to address the question 'Why would this IT system be used?' [8, 13, 14]. This question goes beyond consideration of functionality or usability to address the socio-technical and philosophical complexities inherent in human-intensive systems [2, 15, 16]. Consider teachers currently using traditional classroom methods, wishing to embrace e-learning. Developers could provide support for existing materials to be translated into a virtual learning environment and ensure that teachers have the appropriate buttons and menus to interact with this system. This is intended to bring about an optimization of existing processes for functionality, usability and efficiency. A better result might be achieved if teachers are supported to design how they want to teach using the characteristics of the new environment and its potential to support effective learning, i.e. create a system that is not just user-friendly but meaningful to use. This is intended to result in systems which are purposeful, useful and efficient in supporting strategic change. IS analysts/developers may have every reason to run away from the concept of 'usefulness' and hide instead behind 'functionality' (see discussion in [17]). This can be demonstrated by considering how success or failure of IS developments are measured. A team might be proud of their work in a project that is finished on time and within budget, with all the functionality required in the specification. Often, these are regarded as measures of success, both by developers and leaders of organizations. However, in a documented example [18], one such team received a shock when told that the auditors had pronounced the project a failure! The auditors had noticed a factor not even considered by the team or by managers in the organization – the resultant system was not being used! In such a case, management cannot say that the company is deriving utility from its investment – beyond the book value of the assets involved. Going beyond functionality is difficult and raises the complexity of the task of systems analysis and design. Writing specifically in the field of software engineering, [11] asserts:

> *"… human, social and organizational factors are often critical in determining whether or not a system successfully meets its objectives. Unfortunately, predicting their effects on systems is very difficult for engineers who have little experience of social or cultural studies…. if the designers of a system do not understand that different parts of an organization may actually have conflicting objectives, then any organization-wide system that is developed will inevitably have some dissatisfied users*." p.35.

These difficulties have led IS researchers to focus on human, social and organizational factors, leading some people to fear that relevance to design of IT has been lost [19, 20]. These feelings can be explained as a response to experienced uncertainty, arising from loss of identity and sense of purpose [21]. It is possible that IS

professionals crave certainties derived from adherence to 'technical' needs of system (functionality). What is missing is the important role of Geist – the spirit in the system. When the technical specification has been met, the system still awaits that spirit – the spark of 'life' with which it can only be endowed through use by people who have some context to fulfill [22]. This requires a technical specification being purposeful from the end users' points of view. [23] extends this view in his discussion of design of purposeful social systems. He highlights the importance of the role given to subjective self-reflection in design of such systems. A purposeful system is here defined as one which is self-reflective and at least partially autonomous with regard to its own normative implications, seen not only from the viewpoint of those involved but also those affected by the system. An essential question, for Ulrich, would be 'Does "the designer" design for critical reflection on the part of those who will live/work with the system, including those beyond the immediate group for whom the design is undertaken?' Concepts of functionality, or even usability, may not amount to the experience of meaningful use for those involved. [15] hints at this when he exhorts analysts using soft systems methodology to consider Weltanschauung when conducting an inquiry into a problem situation. This is taken further in work by [17], highlighting the individual perspective that renders a particular view of the situation meaningful to someone. When asked to specify their requirements, potential users of an IS may not be able to express them unless they are supported to explore their individual and collective perspectives on contextual dependencies associated with 'use' [17, 24, 25]. With no opportunity to explore these dimensions of uncertainty and complexity, they may be disappointed in their experienced interactions with newly-created, functional, IS and resort instead to 'work-a-rounds' in order to get the job done. It is this realization which has informed changes in approach to IS development where the supportive role of a professional developer is seen as an on-going mission (loitering with intent) to promote creation of useful systems by and for organizational actors. This contrasts with traditional approaches to development which focus around 'projects'.

Complex Problem Spaces

Complex problem spaces call for sufficiently complex methods for inquiry [26]. References [27, 28] points to a tendency for IS developers to ignore the role of human choice behind the exploitation of technical artifacts, and to use common methods to tackle technical and human dimensions of a design space. We need to exercise our human ingenuity [27, 28] to reflect and adapt methods available to us in order to address complex problem spaces appropriately. IS professional practice requires engagement in what [7] calls 'second order' reflection. When conducting inquiry, many researchers have turned to methodologies intended to simplify organizational problem spaces, in a desire to steer a manageable path through rich, diverse and often 'messy' situated knowledge. However, such attempts to simplify processes of inquiry can lead to pitfalls of reductionism, so that a focus on complexity and emergence is lost. Some of these tendencies towards reductionism include:

Psychological reductionism that can occur if an investigator is assumed (consciously or unconsciously) to be making a description of an external reality which is susceptible to inquiry, i.e. inquiry presupposes a Cartesian split between mind and body [29]. Human beings interact with their environments but their cognitive systems may be regarded as operationally closed, as they are not controlled by such interactions [30]. We cannot describe an objective reality, but only create subjective descriptions of our perceptions of experiences.

As investigators of social phenomena, we may find ourselves becoming entrapped in sociological reductionism, i.e. a focus on group processes, and political dimensions of problem spaces, to an extent which ignores individual uniqueness [31, 32]. No matter how powerless individuals may appear to be, they nevertheless possess a 'freedom' related to their ability to resist and reconstruct social structures.

Philosophical reductionism relates to perspectives from traditional systems thinking, which can be demonstrated to be non-inclusive or 'closed'. Here, system behavior is viewed as an emergent property of interaction between simpler elements within the perceived boundary [15, 33]. In this view, individual elements (including people) disappear, as they are subsumed into the perceived identity of the system [32].

Logical reductionism may arise from misguided assumptions related to classical binary logic [34]. Human reasoning is capable of dealing with complex uncertainties when expressing opinions (and thus multi-valued logic). If a person is asked a question, an answer such as, 'I am not sure' or 'it depends' rather than simply yes or no, is common. However, resultant data for analysis are frequently recorded into simple binary logic. Methods capable of keeping inconsistent or incompatible opinions in view until late in an inquiry are therefore needed in order to avoid such an outcome [35].

Systematic reductionism can occur when analysts try to manage uncertainty by attempting to simplify problem spaces into discrete predicaments, for which solutions may be sought [12]. Such systemic approaches risk incurring a well-recognized problem of sub-optimization [36]. In this paper, therefore, we focus on problem spaces as irreducible.

Any or all of the approaches described above may be valid perspectives on messy, organizational problems such as IS development. It is not the perspectives themselves we wish to highlight as problematic, but distortions arising from unquestioned assumptions based in any of them in isolation. In order to avoid pitfalls of a number of reductionisms, there is a need for contextual inquiry to bring about complexification. Diversity of opinion is a quality to be celebrated in the context of inquiry. A rush to achieve a consensus acceptable to all may screen out an important insight or novel idea which could have held the key to an informed resolution. In order to avoid philosophical reductionism, and to take into account unique individual sense-making processes within an organizational problem arena, we suggest there is a need for analysts to explore multiple levels of contextual dependencies [25]. Every observation which is made is made from the point of view of a particular observer [29]. Since it is not possible to explore a problem space from someone else's point of view, it follows that an external (professional) systems

analyst can only lend support to individual actors within a given context to explore their own sense-making. If an organizational system as an emergent property of unique, individual sense-making processes and interactions within a particular problem arena, individual people are not then subsumed to become invisible. Each exhibit emergent qualities of their own, sometimes greater than those of the perceived system [37]. Efforts to overcome problems of reductionism have been a subject for IS research for some time. Some research [38, 39] focuses on organizational contingencies and contexts. In other work [7, 40, 41], interpretations in local contexts of individuals and groups is explored. [42], recognizing that there is no obvious or necessary consensus over requirements or objectives for an IS, suggest that user-oriented approaches should be adopted [39]. This is supported by work of e.g. [43–45]. Contextual analysis and its relations to individuals, groups and teams are more pronounced in research on continuous development [46, 47]. This work represents a shift in perceptions of the role of a professional developer, away from that of designer of systems for other people to use. There is a transformation towards a facilitating role of friend, guide and helper 'loitering with intent' to support those people to create their own IS for meaningful use. This emphasizes ownership and control of (contextual) inquiry that must rest with the participating actors themselves, rather than professional analysts or managers acting on their behalf [9, 23, 24, 32, 48].

Conclusion

Organizations, formed through the interactions of individual people with multiple perspectives on their working contexts, are arenas in which uncertainties and challenges must be addressed. Thus, at a micro level, within organizations, a need for robust decision-making can be seen. Systematic and holistic means are required to deal with systemic uncertainties. In the face of such perceived uncertainties, we must adopt new perspectives that draw on new concepts and utilize new analytical tools. Methods for IS analysis and design which focus unduly on software intensive systems may, we believe, lead to entrapment in unchallenged assumptions arising from reductionism in various forms. We believe inclusive, contextual approaches are the way forward. A particular challenge in relation to IS development relates to decision processes that involve a range of stakeholders with diverse interests. If IS professionals wish to achieve 'success' in supporting transformation or design of systems for meaningful use (human intensive systems), then unique individual perspectives of these different actors need to be explored. There is clearly a need for approaches to supporting robust decision-making and design. We do not suggest that attention to IT artifacts, including software intensive systems, is not a relevant area for IS professionals to address. However, in this paper, we present an approach to inquiry which aims to overcome some problems of reductionism and provide support for people to address the complexities of human problem spaces with appropriately complex methods.

References

1. Agner-Sigbo, G. (ed). (1993). *To be Continued*. Stockholm: Carlssons Bokforlag (in Swedish)
2. Agner-Sigbo, G. and Ingman, S. (1992). *Self-Steering and Flexibility*. Ord & Form AB: Uppsala (in Swedish)
3. Andersen, N.E., Kensing, F., Lassen, M., Lundin, J., Mathiassen, L., Munk-Madsen, A., and Sorgaard, P. (1990). *Professional Systems Development: Experiences, Ideas and Action*. Prentice-Hall: New York
4. Anderson, D. (2002). LM4: A classically paraconsistent logic for autonomous intelligent machines. Proceedings of the 6th World Multi-Conference on Systemics, Cybernetics and Informatics (SCI 2002), Florida
5. Ashby, R. (1964). *An Introduction to Cybernetics*. Methuen: London
6. Avison, D.E. and Fitzgerald, G. (2005). *Information Systems Development*. McGraw-Hill: Maidenhead, 2nd edition
7. Bateson, G. (1972). *Steps to an Ecology of Mind*. Ballantine: New York
8. Bednar, P.M. (2007). Individual Emergence in Contextual Analysis. Special Issue on Individual Emergence, Systemica, 14(1–6): 23–38
9. Bednar, P.M., Anderson, D., and Welch, C. (2005). Knowledge Creation and Sharing – Complex Methods of Inquiry and Inconsistent Theory. Proceedings of ECKM 2005, Limerick, Ireland
10. Bednar, P.M. and Welch, C. (2006a). Phenomenological Perspectives on IS: Lessons Learnt from Claudio Ciborra. Proceedings of the 3rd itAIS Conference: Information systems and people: Implementing IT in the workplace, Universitá Bocconi, Milan, Italy
11. Bednar, P.M. and Welch, C. (2006b). Incentive and desire: Covering a missing category. Proceedings of Mediterranean Conference on Information Systems, San Serolo, Venice, Italy
12. Bednar, P.M. and Welch, C. (2007). A double helix metaphor for use and usefulness in Informing Systems. In H.-E. Nissen, P.M. Bednar, and C. Welch (eds.), Use and Redesign in IS: Double Helix Relationship? *A Monograph of Informing Science: The International Journal of an Emerging Transdiscipline*, vol. 10, 2009: 293–295.
13. Bertalanffy, L. von (1969). *General Systems Theory*. George Braziller: NY
14. Boulding, K.E. (1953). *The Organizational Revolution*. Harper & Row: NY
15. Checkland, P. (1981). *Systems Thinking, Systems Practice*. Wiley: Chichester
16. Ciborra, C.U. (1992). From thinking to tinkering: The grassroots of strategic information systems. *Information Society*, 8: 297–309
17. Ciborra, C.U. (1998). Crisis and foundations: An inquiry into the nature and limits of models and methods in the information systems discipline. *Journal of Strategic Information Systems*, 7: 5–16
18. Ciborra, C.U. (2002). *The Labyrinths of Information: Challenging the Wisdom of Systems*. Oxford: Oxford University Press
19. Ciborra, C. U. (2004a). Encountering information systems as a phenomenon, in C. Avgerou, C. Ciborra, and F. Land (eds.), *The Social Study of Information and Communication Technology: Innovation, Actors, and Contexts*, Oxford: Oxford University Press
20. Ciborra, C.U. (2004b). Getting to the heart of the situation: The phenomenological roots of situatedness. Interaction Design Institute, Ivrea, Symposium 2005. Accessed June 2007 at: http://projectsfinal.interaction-ivrea.it/web/2004_2005.html
21. De Zeeuw, G. (2007). Foreword. *Systemica* 14(1–6): ix–xi
22. Dervin, B. (1983). An overview of Sense-making research: Concepts, methods, and results to date. International Communication Association annual meeting, Dallas, May 1983
23. Friis, S. (1991). *User Controlled Information Systems Development*. Lund University: Scandinavia
24. Hagerfors, A. (1994). Co-Learning in Participative Systems Design. Lund University: Scandinavia

25. Bednar, P. (2000). A contextual integration of individual and organizational learning perspectives as part of IS analysis. *Informing Science: The International Journal of an Emerging Transdiscipline*, 3(3): 145–156
26. Hevner, A., March, S., Park, J., and Ram, S. (2004). Design science research in information systems. *MIS Quarterly*, 28(1): 75–105
27. Hirschheim, R. and Klein, H.K. (1994). Realizing emancipatory principles in information systems development: The case for ETHICS. *MIS Quarterly*, 18: 83–109
28. Hirschheim, R., Klein, H.K., and Lyytinen, K. (1995). *Information System Development and Data Modeling: Conceptual and Philosophical Foundations*. Cambridge University Press: Cambridge
29. Ingman, S. (1997). *Trust and Computer Use*. Lund University (in Swedish): Scandinavia
30. Langefors, B. (1966). *Theoretical Analysis of Information Systems*. Lund University: Studentlitteratur
31. Marchand, D. and Hykes, A. (2006). IMD Perspectives for Managers No.138, Designed to Fail: Why IT-enabled Business Projects Underachieve. 15th European Conference, St Gallen, Switzerland, at http://www.ecis2007.ch/conference_programme.php, Accessed 25 July 2007
32. Mathiassen, L., Munk-Madsen, A., Nielsen, P.A., and Stage, J. (2000). *Object-Oriented Analysis & Design*. Marko Publishing House: Aalborg
33. Maturana, H.R. and Varela, F.J. (1980). *Autopoiesis and Cognition*. Reidel: Dordrecht
34. Mumford, E. (1983). *Designing Human Systems For New Technology: The ETHICS Method*. Manchester Business School: Manchester
35. Mumford, E. (1995). *Effective Systems Design and Requirements Analysis*. Macmillan: Basingstoke
36. Nissen, H.-E. (2007). Using Double Helix Relationships to Understand and Change Informing Systems. In H.-E. Nissen, et al. (eds.) Use and Redesign in IS: Double Helix Relationship? *A Monograph of Informing Science: The International Journal of an Emerging Transdiscipline*, vol. 10, 2009: 29–62.
37. Olerup, A. (1982). *A Contextual Framework for Computerized Information Systems*. Nyt Nordisk Forlag Arnold Busk: Copenhagen, Denmark
38. Orlikowski, W.J. and Iacono, C.S. (2001). Desperately seeking the 'IT' in IT research – a call to theorizing the IT artifact. *Information Systems Research*, 12(2): 121–134
39. Radnitzky, G. (1970). *Contemporary Schools of Metascience*. Akademiforlaget: Gothenburg
40. Sandstrom, G. (1985). *Towards Transparent Databases*. Lund University: Studentlitteratur
41. Sims, D. (2004). The Velveteen Rabbit and Passionate Feelings for Organizations. Chapter 13 in *Myths, Stories and Organization*. Y. Gabriel (ed.). Oxford University Press: Oxford
42. Sommerville, I. (2004). *Software Engineering*. Addison Wesley: San Diego, 7th Edition
43. Stowell, F.A. and West, D. (1995). *Client-Led Design*. McGraw Hill: NY
44. Suchman, L.A. (1987). *Plans and Situated Actions: The Problem of Human Machine Communication*. Cambridge University Press: Cambridge
45. Ulrich, W. (1983). *Critical Heuristics of Social Planning: A New Approach to Practical Philosophy*. Wiley: Chichester
46. Ulrich, W. (2001). Critically systemic discourse: A discursive approach to reflective practice in ISD. *The Journal of Information Technology Theory and Application* (JITTA), 3(3): 55–106
47. Weber, R. (2003). Still desperately Seeking the IT artifact. *MIS Quarterly*, 27(2): iii–xi
48. Weick, K. (1995). *Sense-Making in Organizations*. Sage: Thousand Oaks, CA

Modeling Business Processes with "Building Blocks"

A. Di Leva and P. Laguzzi

Abstract Over the past years, organizations face unprecedented competition, forcing them to offer exceptional levels of service, at whichever sector of the productive business process they find themselves. For this reason, they began to study, analyse and modify their business processes from a BPM (Business Process Management) point of view, in order to improve their products and to be more and more efficient. Our research evolved from the study of the small ad medium manufacturing industry domain, aiming to construct generic building blocks which can be composed to represent the original processes. Using pre-built building blocks allows to raise efficiency and effectiveness, encouraging flexibility and promoting reuse inside the analysis, design and implementation phases.

Introduction

In order to achieve more flexibility and excellence in business management, companies today have to acquire all the mechanisms and tools for supporting decision operations, daily practicality and reporting. This request of dynamism inside organizations brought to the research of excellence in business process. To achieve this, the role of business processes has been continuously growing: in fact, it's essential to make processes transparent, easily adaptable to new regulations, standardized, reusable, traceable, structured, flexible and automated.

Detecting recurrent processes inside organization belonging to the same market, and standardize them through the creation of pattern or "building blocks" allows to reveal acquired information at all operational and management levels and en-courage communication, flexibility and reuse. Our research originated from the analysis of business processes inside small/medium manufacturing organizations, leading up to the construction of about 40 generic building blocks which can be

Università di Torino, Dipartimento di Informatica, Torino, Italy, dileva@di.unito.it, laguzzi@di.unito.it

composed to represent the original processes. In the rest of the paper, we will outline the research method we used and we will provide an example of building block we identified and modelled through the BPMN language [1].

The Business Building Blocks

The idea of building block belongs to several disciplines. Inside our study, we particularly pointed out business process building blocks. According to the BETADE project [2]:

> *. . . a building block is self-contained (nearly-independent), interoperable (independent of underlying technology), reusable and replaceable unit, encapsulating its internal structure and providing useful services or functionality to its environment through precisely defined interfaces. A building block may be customized in order to match the specific requirements of the environment in which it is used . . .*

Based on our experience, and inspired by [2, 3], the following list of properties of building blocks can be given:

- *Usable in different studies*: the development of building blocks is a time-consuming activity. This means that they should be built in order to be applicable to different studies. They should be independent from other building blocks and they should cooperate at the same time with other building blocks in order to build complex models and patterns.
- *Applicable to different modelling and/or simulation tools on the market*.
- *Usable only through their interface*: a building block should be used only through its interface. The interface of a building block has to be considered as a set of services that can be provided to the outfield.
- *Able to support system designers for the development of easily-maintainable models*: building blocks ought to help the development of models from the design to the fulfilment.
- *Easily valuable and verifiable*: after building, the model ought to be verified and validated in order to avoid unpleasant troubles on the output. The model built with building blocks should be easily and quickly verifiable and valuable.
- *Easily adaptable*: often business process evolve from time to time. This means that every model should be adaptable and changeable with smaller effort. The use of building blocks should make these adaptations easier and should ease process changes.
- *Easily extendable*: in order to make the model more maintainable, building blocks ought to be easily extensible to fulfil the requirement from different system.
- *Manageable*: it's better to build building blocks with minimal and essential features. If building blocks have much of unused features, a larger overhead per building block is expected, that means less maintainability from the user perspective.

- *It can be seen as a white box or a black box*: a building block can be seen as a black box, with interfaces that specify some internal behaviour, but also as a white box, in which the behaviour is represented in a formal way, to allow, i.e., the block's validation.
- *Open to services*: it is the ability to integrate into Web-service technology.

The requirements of building blocks should be defined from the perspective of three different actors: final user, administrator, and designer. In short, we can assume that the final user (the actor that will use the result of the modelling in order to take decisions) is not interested in technical details, but to the support he will get in order to arrange a correct, validated, useful, and expansible model. The administrator (the person responsible for the maintenance of the model) will request flexibility, scalability and maintainability. Otherwise, for the designer it is fundamental that building blocks are generic, reusable, and modular.

Discovery and Use of Building Blocks

Discovering building blocks inside a domain could be critical because it usually involves people and teams from across the enterprise. Moreover, it is an ongoing iterative process, which requires a robust methodology to construct a business process model (a set of business processes) and a set of building blocks, and then to express the discovered processes in terms of cooperating building blocks. The methodology (still under development) we used in our approach, suggests the steps outlined below.

1. Identification of the target domain and the relative critical business processes.
2. Documentation of the domain and the business processes as a set of user requirements.
3. Specification of user requirements in terms of process flow descriptions. For this step, the help of a domain expert will be required for both process flow descriptions and for the final acknowledge of the business model.
4. Split of the processes in smaller processes (top-down approach).
5. Identification of recurrent sub-processes inside the target domain and construction of the related building blocks (and interfaces).
6. Standardization of the business processes through the building blocks.

If building block identification has been correctly completed, it will be easy to implement new process models using them. A black-box approach is recommended. This will lead to building blocks that can be used early to do some first modelling activities (like developing test models) and getting insight in the benefits or weaknesses of the building blocks regarding visualization, representation, ease-of-use, and outputs.

Moreover, it is important to consider some other details. First, the building block designer must have a good experience regarding the design and the implementation of building blocks: often, there are different ways to model a situation, all with their

own advantages and disadvantages. The building block designer should be able to find the better solution, which means the quicker one but also the most understandable and maintainable. Obviously, an effective cooperation between block designer and domain expert is needed. This synergy is essential because the building block designer is a modelling expert that, usually, hasn't the knowledge and the background owned by the domain expert.

In order to get a real benefit using building blocks, it is fundamental to have a suitable and complete documentation. This means that the design of the building blocks has to go always with an interface that describes its attributes and its behaviour clearly and unequivocally. A building block must own the following attributes: name, description, solution, consequences, structure, example, relative pattern/building block, author and responsible (not all the attributes are mandatory). According to our experience, we believe that minimal attributes for building block should be: name, description, structure, solution and responsible.

Complying to business process standards for process representation, we use the BPMN (Business Process Modelling Notation) language for the description of the building blocks. BPMN is a graphical notation that has been specifically designed to coordinate the sequence of processes and the messages that flow between different process participants in a related set of activities [1].

Moreover, BPMN specifications can be simulated by means of discrete event simulation tools, nowadays available on the market (like iGrafxProcess [4]). Through simulation, the block designer can manipulate building blocks to check their semantic correctness and to see where inefficiencies lie. It is also important to remember that the simulation allows an effective "what-if" analysis, checking hypothetical business scenarios, and highlight workloads, resources (in terms of costs and scheduling), and activities (durations, costs, resource consumption).

At last, BPMN objects can be mapped in BPEL, that is the Business Process Execution Language for Web Services [5]. For instance, iGrafxProcess converts BPMN diagrams to BPEL files which specify the sequence of Web Services to be executed.

Once building blocks have been discovered and mapped along with the description of their interface, they can be used in different context and applications.

In order to allow communication between building blocks, their interface should be conveniently manipulated. In fact, the input interface will allow parameters to take convenient values, which will be internally transformed in order to re-turn output that will be used as input for other building blocks, and so on. This process entails that each building block will have an input and output interface, which will allow the communication with the other instances.

The building blocks repository plays a crucial role in the building blocks architecture. The repository is a container able to host the building blocks and to make them available on demand. Therefore, the repository should be a safe container with an appropriate search engine in order to search building blocks through their attributes. It must consider all the element of the interface and it must be able to combine them conveniently through Boolean operators.

Because of the importance of its role, it is mandatory to keep the repository in a safe place, implementing suitable security policies, verifying periodically his structure and keeping up to date the data retrieval interface according to user needs.

Moreover, it is especially important to catalogue building blocks inside the repository. Building blocks can be grouped according to various perspectives. The control-flow perspective captures aspects related to control-flow dependencies between various activities (e.g. parallelism, choice, synchronization, exception handling, etc.). The data perspective deals with the passing of information, scoping of variables, etc., while the resource perspective deals with resource to activities allocation, scheduling, delegation, resource consumption, etc. Alternatively, building blocks can be grouped from a business perspective, based on what the building block represents (based on our case study, a possible grouping could be Get Order, Develop Product, Fulfil Order, Obtain Request items, Support Product, etc.), or based on the departments involved in their use or in their implementation.

Building Blocks for a Small/Medium Manufacturing Company

Our research has, at last, focused on a real case study trying to apply the concepts previously described. We studied and analysed some standard business process of a set of typical small/medium manufacturing enterprises. The main processes of a small/medium manufacturing enterprise can be split in three different categories: management process, operational processes and support processes. Our research aimed to the discovery of building blocks concerning operational processes. For each designed building block we identified an interface and we highlighted main features and attributes.

In Fig. 1 an example of building block identified in the case study is illustrated.

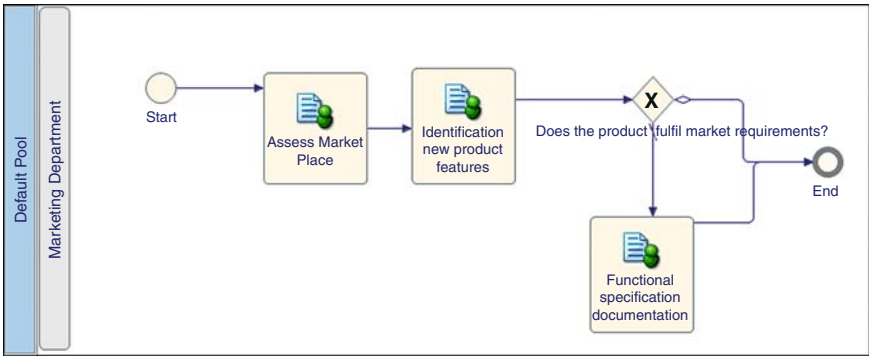


Fig. 1 The BB_Identify_Opportunities building block

Conclusions

Rapidity of design, a model easy to validate and extend, greater standardization and ease of reuse: we listed just some of the benefits that the use of building blocks can bring inside an organization. Also, through simulation, the analyst will be able to analyse results and quickly identify bottlenecks. He will be able to bring suitable modifications, retry other simulations against other input parameters and verify the trend. In this way, different scenarios will be produced and all the needed elements to undertake a decision making process will be available.

Our research was limited to highlight the benefit of an enterprise who identify and design building blocks. An additional and interesting analysis could be the verification of the real advantage when using building blocks in the process modelling in a small/medium manufacturing organization through the study of a real complex project, with and without using and maintaining building blocks. In this way we would demonstrate the actual benefit using building blocks, applied to the entire life-cycle of the processes. This would allow to quantify the real effectiveness and to optimize potential deficiencies.

In the future we plan to extend our work by developing a prototype system based on an ontology of building blocks related to a given domain. The system should: (a) assist the end user in semantic annotation of existing BPMN building blocks, i.e. adding references to ontology elements, goals and semantic constraints; (b) allow storing into the repository the "semantic" building blocks and querying for discovery of existing semantic components to build new processes; and (c) allow a semi-automatic transformation from BPMN specifications to executable BPEL models.

References

1. BPMN (Business Process Modeling Notation) (2006). BPMN 1.0: OMG Final Adopted Specification, February 6
2. van der Aalst, W.M.P., ter Hofstede, A.H.M., Kiepuszewski, B., and Barros, A.P. (2003). Workflow Patterns. *Distributed and Parallel Databases*, 14(3), 5–51
3. Dahanayake, A. and Verbraeck, A. (eds.) (2002). Building Blocks for Effective Telematics Application Development and Evaluation. http://www.betade.tudelft.nl/reports/
4. iGrafx.com: Unlocking the Potential of Business Process Management http://portal.igrafx.com/downloads/documents/bpm_whitepaper.pdf
5. White, S.A. (2005). Using BPMN to Model a BPEL Process. *BPTrends* 3, 1–18

Software Development and Feedback from Usability Evaluations

R.T. Høegh

Abstract This paper presents a study of the strengths and weaknesses of written, multimedia and oral feedback from usability evaluations to developers. The strengths and weaknesses are related to how well the feedback supports the developers in addressing usability problems in a software system. The study concludes that using the traditional written usability report, as the only form of feedback from usability evaluations is associated with problems related to the report not supporting the process of addressing the usability problems. The report is criticized for representing an overwhelming amount of information, while still not offering the required information to address usability problems. Other forms of feedback, such as oral or multimedia feedback helps the developer in understanding the usability problems better, but are on the other hand less cost-effective than a written description.

Introduction

Development of user-friendly software is a complex task. Many factors influence whether or not the software project will be a success. It is generally agreed that a software project has a higher chance of success, when the designers and developers has a good understanding of the future users and the software's use situation [1]. In order to develop user-friendly software, it is furthermore recommended that activities to ensure the usability of the software are carried out throughout the various stages of the software development. In the early stages exploratory tests can be carried out on low-fidelity prototypes, to explore the potential of preliminary design concepts. Assessment tests can be done on operational prototypes of the system, where the goal is to evaluate if specific design choices are appropriate. Validations tests are typically done on the final system, with the goal being to evaluate the system entire system as a whole [2]. Common for all the stages in the development

Aalborg University, Department of Computer Science, Denmark, runethh@cs.aau.dk

process and the usability evaluation methods is that the development team, in order for them to improve and develop the product, needs the evaluation results.

The traditionally recommended form of feedback is a written report [2, 3]. Practical experiences with the written report however reveal that it may not always be the most optimal form of feedback, [4] as developers has been reported not to use the report, when working with the software. Alternative forms of feedback include oral feedback, and multimedia presentations. This study examines the strengths and weaknesses in the three mentioned forms of feedback.

Related Work

A recent study of the impact of feedback from usability evaluations report that usability reports can have a strong impact on the developers' opinion about their software [4]. The same study however also report that usability reports may not always be used, partly because the studied development team made no effort to systematically address the usability problems described in the usability report because the development team had limited resources to use on redesign and rework of their software. The study reports from a singly study, but the same type of problems were experienced in the study reported in this paper.

Feedback from usability evaluations is still an emerging field, and most research has been focused on the written feedback. There are a number of advices on what content to include in a usability report [2, 3]. Others such as Frøkjær and Hornbæk [5] have studied practitioners' criticism of the traditional usability report. They conclude that the practitioners were interested in constructive proposals for redesign along with descriptions of usability problems. Few studies have had a focus on feedback, where the form has been an alternative form than the written report. It is however recognized that it is not trivial to ensure that feedback from usability evaluations have an impact on the software.

Method

This section presents a study designed to investigate and compare the strengths and weaknesses of the written feedback form to feedback given in a redesign workshop consisting of oral feedback accompanied by a multimedia presentation. Two development teams from two software projects in a large Danish software company participated in this study.

The company develops software to the telecommunication industry, and both the software projects had been developed on for more than two years. Both of the software products had extensive graphical user interfaces designed to present complex information.

Table 1 An overview of the structure of the study

Project A	Project B
Usability evaluation of software with users	
Preparation of written usability report	Preparation of redesign workshop
Developers read usability report	Developers participate in redesign workshop
Immediate feedback on the usability report	Immediate feedback on the redesign workshop
Developers work with their software for one iteration	
Feedback on the long-term use of the usability report	Feedback on the long-term use of the redesign workshop

The developers from each software projects were male from the age of 27–45, who all had a masters degree in computer science or similar. All of the participants had worked with the software for at least a year. Four graphical user interface developers from project A were involved in the study, and three graphical user interface developers were involved from project B. The involved developers represented all the graphical user interface developers on the two projects. The company furthermore employed two male human factor specialists who also had a masters degree in computer science.

The software from each team was usability evaluated with users in a state-of-the-art usability laboratory. The users were asked to solve a number of tasks that the software was typically used for, and the users were asked to think-aloud while doing it. The usability evaluation was recorded on video. The author afterwards analyzed the video. After the analysis two types of feedback was prepared; a traditional written report, and a multimedia presentation designed to be used in a feedback workshop. The feedback was given to the two project teams separately. Project A was given a written report, and project B participated in the redesign workshop. When the feedback was given, the developers where asked about their immediate response to the feedback. After the feedback session the developers worked with the software for a full iteration. After one development iteration, the developers asked how they had used the given feedback during the iteration. Table 1 depicts the procedure of the study.

The Written Report

The developers in project A were all invited into the usability lab. They were there given the usability report and asked to read it individually in full length. After they had all finished reading it, they were interviewed together about their immediate response to the feedback. The session took about 1 h. The usability report was structured as depicted in Table 2

Table 2 The structure of the usability reports

Usability report structure		
1. Summary	**4. Usability problems**	**6. Appendix**
2. Method	(a) Problem list	(a) Tasks
(a) Purpose	(b) Detailed description of problems	(b) Introduction
(b) Procedure	(c) Screen dumps	(c) Log files
(c) Test participants	**5. Conclusion**	
(d) Test procedure		

Bold numbers denotes chapters and letters sections

The Redesign Workshop

The human factors experts, the developers in project B and the author participated in the redesign workshop. Previous to the workshop had the human factors experts and the author analyzed the usability results, and identified the ten most significant usability problems. For each of the ten most significant usability problems a short video-clip was prepared. The video-clips showed situations where a user was having trouble with the software due to usability problems. For the reminder of the usability problems, a written list with descriptions was prepared. In the workshop, the developers were first presented with an overview of the usability problem, and they were then presented with the most significant usability problems one at a time. First the author described a usability problem, and then they developers watched a video-clip with the usability problem, and afterwards followed a discussion on how to address the usability problem. The human-factors experts participated in the discussion where pros and cons of redesign proposals were discussed.

Results

The developers who received feedback in the form of a written report felt that the report was a good tool to get a quick overview of the software's overall state. With a quick glance on the summary and the lists of usability problems the developers could get the overview they found to be one of the most important answers of the usability evaluations. The overview was an important factor in their work, as it influenced how many resources they should expect to use to rework to software.

In relation to the individual usability problems, the developers found it a great help to be able to read in the log when and how the usability problem had occurred. They said that most of the times they could understand the description of the usability problems, but sometimes they needed to put the usability problems into a context.

One of the drawbacks of the usability report was the sheer amount of information in the report. The developers mentioned that had they not been asked to read the report in full length as a part of the study, they probably would not have done it.

The report contained around 70 usability problems, along with other information. All that information meant that the developers felt overwhelmed from the start.

Regarding the long-term use of the report, only one developer had used the report after the meeting. A few months into the next iteration of the software, the developer had used the report to gauge the resources needed to finish some areas of the graphical user interface. The two other developers said that they had meant to use the report, but never got around to open it. They said that it was because of the size of the report, and because of the limited resources the project had to use on rework of old code. The developers did however point out that several of the mentioned usability problems had been addressed in the latest iteration, but that the report had not been used for it.

The developers who participated in the redesign workshop said that the oral description of the usability problems helped them to understand what they saw in the video clips, and that the video clips were great to help them understand the problems and the users' frustrations. They furthermore said that seeing the video-clips helped them form redesign ideas.

The discussion of the redesign ideas also received positive comments. The developers liked that they could discuss their ideas with the human factors experts, so that they felt confident that redesign solutions would amend the usability problems, rather than just creating new usability problems.

The developers furthermore liked that only the most significant usability problems were in focus, as they said that they only had limited resources to redesign the system. They were however unhappy with the amount of time it took to reach an agreement with the human factors expert. They felt that a lot of resources were being used on discussing design ideas. They furthermore felt frustrated that each usability problem was only dealt with on design level. They wanted to go into more detail, and finish all relevant discussions for each redesign decision, rather than just discussing on design level.

When asked about the long-term use of the feedback, the developers said they mainly relied on memory of the video-clips to come up with redesign proposals. None of the developers had seen the video-clips again. The complete list of usability problems had been used in the days after the redesign workshop. The list was used to plan which areas of the graphical user interface to address. The list had not been used anymore after that. Again the developers pointed out that many of the usability problems found in the evaluation had been addressed, but the developers had not used other parts of the feedback than what was still in their memory.

Discussion

The results from the study regarding the written usability report are consistent with the findings from [4]. The usability report helped the developers to understand the strengths and weaknesses of the system and the developers in both studies pointed out the same parts of the report as being the essential parts, namely the problem

lists, the detailed descriptions of the problems and the log files. The study presented in [4] does not take into a longitudinal perspective into account. In this study both software teams used the feedback items very little after they had received it. They relieved on their memory of the feedback session to address the usability problems in the software. This is of course not optimal given that the average persons memory would be strained to remember all the usability problems in the software. In the respective projects this was however not needed. The developers decided along with the management to mainly focus on a smaller number of usability problems. This was decided because of the shortness of resources and time.

The experiences from the two feedback sessions reveal a number of items that appear to be important to developers. Both teams of developers agree that feedback must be of a non-overwhelming amount, and that it must provide an overview. All the developers agreed that they preferred focused and detailed information about the most significant usability problems, rather than large amount of information on every usability problem. They were happy with less detailed information about less severe problems. They also felt that it was important that the time spend on receiving the feedback was in a reasonable balance to the time it would take to address the issues. Both software projects were pressed for time and because of that, they were looking for the redesign solutions that would cost the fewest resources. They would rather accept a design solution that would mend a usability problem into a less severe usability problem, than do a large-scale rework of an interface to completely avoid the usability problem. That is a lesson to remember for those that do give input to redesign suggestions. They were however happy with getting the optimal solution suggestions, and especially the dialogue in the redesign workshop were used to reach a common compromise between the technical restraints introduced by the software structure and the ideal solution suggested by the human factor specialists.

The usability report is a very structured document that appears to be ideal for a systematic approach for addressing usability problems. Two different studies from two different companies have however reported that the usability report is not used in a systematic approach to address the usability problems. This may of course have something to do with the specific companies, and hence it may not be general situation. In this study it was however the case that a smaller selection of the usability problems were chosen by the developers to be addressed. The selection of usability problems that were addressed were somewhat influenced by the severity rating of the usability problems, but it was not the only factor. In the study presented in this paper, usability problems were selected for a number of other reasons than their severity. Some usability problems were addressed because they were easy to fix, others were addressed because a new functionality influenced the already existing graphical user interface, and the usability problem was addressed as a part of the integration of the new functionality in the graphical user interface. Finally some usability problems were simply addressed because some developers had more time than others to do rework in the areas of the graphical user interface they were responsible for. Other usability problems were specifically not addressed because they would influence too many software modules or because the responsible developer was tied up with other responsibilities.

Further Work

The traditional usability report does not take the above-mentioned factors into account. The human computer interaction field may have something to learn about how the feedback from usability evaluations is used by the developers to whom it was addressed. With a better understanding of the process of addressing usability problems, it may be possible to optimize the feedback to better suit the work of the developers.

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References

1. Mathiasen, L., Munk-Madsen, A., Nielsen, P. A., and Stage, J. (1998). *Objektorienteret analyse og design*. Aalborg: Marko ApS
2. Rubin, J. (1994). *Handbook of usability testing: How to plan, design, and conduct effective tests*. New York, NY: John Wiley
3. Dumas, J. S. and Redish, J. C. (1993). *A practical guide to usability testing*. Norwood, NJ: Ablex
4. Høegh, R. T., Nielsen, C. M., Overgard, M., Pedersen, M. B., and Stage, J. (2006). A Qualitative Study of Feedback from Usability Evaluation to Interaction Design: Are Usability Reports Any Good? pp. 173–196. *International Journal of Human-Computer Interaction*, volume 21, number 2, New York, NY: Erlbaum
5. Frøkjær, E. and Hornbæk, K. (2004). Input from Usability Evaluation in the Form of Problems and Redesign: Results from Interviews with Developers. In Hornbæk, K. and Stage, J. (Eds.), *Proceedings of the Workshop on Improving the Interplay between Usability Evaluation and User Interface Design, NordiCHI 2004*, pp. 27–30. Aalborg University, Department of Computer Science, HCI-Lap Report no 2004/2

A Methodology for the Planning of Appropriate Egovernment Services

G. Viscusi and D. Cherubini

Abstract In this paper we present a methodology supporting the planning of eGovernment services on the basis of the appropriateness of the services for the users. Appropriateness is a boundary concept, defining the line of visibility involved in service provision. Besides appropriateness, the concept of homology of the system helps to grasp the tangle between socio-cultural and technical issues. The methodology, indeed, allows the design of service aiming to (a) enhance the users capabilities and (b) fulfill planned target objectives. To these ends, the paper introduces the Scenery and Context Indicators (SCI) tool for eGovernment projects evaluation. An example of SCI application is discussed, considering the dependencies between social and technological systems.

Introduction

Planning activity is a crucial issue in the management of information systems, due to the different *facets* of an organization and of its surrounding environment [1, 2]. In eGovernment planning, perspectives from different disciplines have to be considered in their interaction [3], while the need of a comprehensive framework is currently a research issue [4]. To these ends, the GovQual methodology for the planning of eGovernment projects, developed within the eG4M Project, exploits a multidisciplinary approach, extending the focus to social issues [5, 6]. The methodology is not tied to specific IT solutions, and is composed by four main phases: (a) *state reconstruction*, (b) *assessment*, (c) *new quality targets definition*, and (d) *preliminary design and choice of projects* [6]. In this paper we present the GovQual methodology by focusing on the *appropriateness* of the services for the users and *homology of the system*. We consider appropriateness as a concept, defining

Università degli Studi di Milano Bicocca, Milano, Italy, viscusi@disco.unimib.it, daniela. cherubini@unimib.it

the *line of visibility* involved in service provision [7, 8], helping, together with the concept of homology of the system, to grasp the tangle between socio-cultural and technical issues. The two concepts are introduced in section "Homology of the System and Appropriateness." In section "The Scenery and Context Indicators Tool", we describe the Scenery and Context Indicators (SCI) tool for eGovernment projects evaluation, implementing the above vision in the methodology. Section "Application of the SCI Tool in GovQual" discusses an example of application of the SCI tool. Future work (section "Conclusion and Future Work") conclude the paper.

Homology of the System and Appropriateness

Boudon [9] introduces the concept of *homology of the system* or *structure* to describe a methodological principle from sociological analysis, establishing a structural correspondence between two phenomena or between two coherent systems of meaning and action. In our work the concept of homology contributes to explain the level and degree of diffusion of a certain technology within a social context (or between different contexts), assuring the coherence between technologies and social systems [10]. For example, homology allows to ascertain the correspondence between the behavior of a population towards a new technological application (adoption, rejection) and its cultural capital. Indeed, in GovQual, homology is relevant for scenery reconstruction at a macrolevel.

Appropriateness is the capability of detecting and enhancing the potential of the context [11]. In GovQual, appropriateness concerns the adaptation of eGovernment services to the context, both at the macro (scenery) and micro (user's context) level. Appropriateness contributes to the GovQual approach to eReadiness [12], together with theoretical perspectives that evaluate the *capability* [13] of a system to achieve valuable goods or beings, namely, *functionings* [14], and to convert them into *utilities*. In GovQual, eReadiness assessment supports the planning of eGovernment projects, by fixing the socio/political environment constraints, and identifying the appropriate eGovernment solutions.

The Scenery and Context Indicators Tool

The GovQual methodology exploits a Scenery and Context Indicators (SCI) tool for the collection and analysis of data, and for the monitoring of the different phases of eGovernment interventions, grounding them on the knowledge of the social issues of a given context. SCI is a modular tool composed by a set of indicators structured on the basis of the (a) *level of analysis*, namely macro (analysis of the scenery), and micro (field analysis) level; (b) *area*, namely *socio-economical context*, *ICT access and diffusion*, *analysis of the users*, and *analysis of services*. The set of indicators for the dimensions to be considered are provided for each level of analysis and area,

on the basis of the specific objectives and goals of the project planning. SCI is used in the state reconstruction (macrolevel analysis) and in the assessment phase for the evaluation of the context's resources and capabilities (microlevel analysis). In the following section, we consider the application of the SCI tool to an example of planning of e-health services for the choice and the revocation of the family doctor. The service is planned in an hypothetic region with an high flow of migration due to the availability of a dynamic labor market, related to the presence of competitive small medium enterprises in the surrounding of five medium towns. In this context, the service is relevant for its relatedness with the change of residency, in particular for citizens coming from rural area from the other districts of same country. In the current context, health care service faces difficulty in fulfilling users' demand, due to the burdensome and unfunctional organization of the bureaucratic procedures which mediate the relationships with its beneficiaries. In particular, the basic health services, such as medical examinations, entail long procedures and long waits in order to be provided and requested by users. Referring to our example, these procedures cannot proceed without the prescription by the family doctor. Indeed, every citizen must have a family doctor assigned.

Application of the SCI Tool in GovQual

In the above described scenario, the SCI tool is first applied to the state reconstruction phase; this phase is grounded on the secondary analysis of available data, in order to get a preliminary detailed snapshot of the context. In the example, we assume that the secondary analysis produces the results shown in Table 1. The indicators offer a representation of the present-day ICT access and diffusion in the country, showing that mobile telephony is a more spread technology than Internet, and that many people have easier access to the former than to the latter, due to their costs. The indicators show also a quite high ICT literacy rate among young people (45% of 14–25 years-old people, which represent 30% of total population, have a

Table 1 SCI application in GovQual State Reconstruction phase

Dimension	Indicators	Value
Socio-demographic context	ICT literacy rate (% on total population)	25
Socio-demographic context	ICT literacy rate (% among 14–25 years-old)	45
Infrastructural access	% of population covered by mobile cellular telephony	45
Infrastructural access	% of population with Internet connection at home	3
Infrastructural access	% of schools equipped with computers	60
Real access	Cost of Internet access	High
Real access	Cost of mobile phone services	Medium
Real access	% of people that can have access to Internet (at school, work, other access points)	20

basic knowledge of the use of a PC), and a high diffusion of ICT in the educational system (60% of schools equipped with computers).

A reading of these indicators suggests that, on the one hand, due to the large number of users of cellular phones with respect to the users of Internet, and due to the costs of internet access, eGovernment initiatives in our hypothetical country have to consider as a major issue the service provision through multichannel systems. On the other hand, indicators suggest that in the long term period it is possible to invest efforts in the progressive extension of the Internet service provision, due to the high rate of young population and to the ICT diffusion in the educational system. Furthermore, in a second step, SCI is used to assess the level of eReadiness of the specific context of intervention, with reference to the users of the services involved in the eGovernment program.

In this phase, SCI merges primary data collected through ad hoc surveys to representative samples of real/potential users, and secondary data from administrative sources. Table 2 shows the results of the analysis for the assessment of the ICT access, the ICT use, and of the disposition towards innovation. In the example, users are divided in two categories, according to their urban/rural context of origin. Among all the users, mobile phones are more spread (43%) and used (55% of users can send a sms) than Internet (18% of users have access to Internet, and 14% can send an e-mail). These features are confirmed considering the domestic access to Internet (just 2% of users, 0.8% of users from rural contexts); other kinds of Internet access (at work, school, public or commercial points of access) are not widespread.

The analysis shows that most of the users have a good disposition toward innovation, reasonable knowledge capabilities in ICT issues, but no easy access to Internet; whereas, they have a fairly good access to mobile phones. These results confirm data from the state reconstruction phase and may orientate the reorganization of the services related to the choice of a family doctor towards multichannel solutions. The results may also suggest to support the reorganization of administrative services with the enhancement of access capabilities for the involved categories of user: public access points could provide access to users with a good disposition towards Internet, but who cannot afford domestic access. In conclusion, the results of the application of SCI suggest that project planning have to consider solutions that improve the traditional desk service, in the short period, through a back-office reorganization or through normative solutions, such as, e.g. auto certification; while full internet based solutions must be planned for a medium period, exploiting the results of the desk improvement, and the growing of the ICTs capabilities, e.g. through the school access to internet.

Furthermore, solutions that involve most sophisticated tools such as, e.g. smart cards, must be planned for the long period, because of their need for additional instruments besides the personal computer (e.g. smart card readers), implying additional costs of access, and a knowledge of the required procedures for their use, by citizens that, e.g. due to their age and level of literacy, have low readiness toward widespread used technologies such as portals or internet based solutions.

Table 2 SCI application in GovQual Assessment phase

Dimension	Indicators	Rural → urban users	Urban → urban users	Value
Household/private access	% of users with mobile phone	30.0	62.5	43.0
Household/private access	% of users with Internet connection at home	0.8	3.8	2.0
Public/working access	% of users who have access to Internet outside home (work + school + public points)	13.0	25.5	18.0
ICT knowledge	% users with a basic ICT literacy level	16.7	37.5	25.0
ICT use	% users who can send a mail with an attachment	10.0	20.0	14.0
ICT use	% users who can send a message of text (sms) by mobile phone	40.0	77.5	55.0
Attitude toward ICT (trust level and disposition towards its use)	% users who declare a positive or high positive disposition toward technology: internet	50.0	55.0	52.0
Attitude toward ICT (trust level and disposition towards its use)	% users who declare a positive or high positive disposition toward technology: mobile phone	70.0	80.0	74.0
Attitude toward ICT (trust level and disposition towards its use)	% users who declare to be high sensitive to ICT-related security and privacy issues	13.3	42.5	24.8
Total		60%	40%	100%

Conclusion and Future Work

The paper presents the GovQual methodology for planning eGovernment initiatives focusing on the concepts of appropriateness of services and homology of the system, and on an application of the SCI tool. We are now committed to applying the methodology in public administrations of Mediterranean countries. A relevant issue will concern the extension of qualitative methods illustrated in the paper with quantitative evaluations. Finally, we are currently designing an industrial tool that supports the eG4M designer. A first version of the tool will be provided in 2008.

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References

1. Avison, D.E. and Fitzgerald, G. (1995). *Information Systems Development: Methodologies, Techniques and Tools*. UK: McGraw-Hill
2. De Michelis, G., Dubois, E., Jarke, M., Matthes, F., Mylopoulos, J., Schmidt, J.W., Woo, C., and Yu, E. (1998). A Three-Facet Information. *Communications of the ACM*, 41(12): 64–70
3. Galliers, R.D. (2004). Trans-disciplinary research in information systems. *International Journal of Information Management*, 24(1): 99–106
4. Tan, C.W. and Benbasat, I. (2006). Comparing e-Government Development Process Frameworks: Towards an Integrated Direction for Future Research. In: Proceedings of the Seventh Mediterranean Conference on Information Systems MCIS'06 – October 5–8, Venice, Italy, 1: 42–52
5. De Michelis, G., Casaglia, A., and Cherubini, D. (2007). eProcurement as a Learning Process: What Social and Organizational Concerns Tell to System Development. In: Proceedings of the. Sixth International EGOV Conference 2007, Regensburg (Germany)
6. Viscusi, G., Batini, C., Cherubini, D., and Maurino, A. (2007). A Quality Driven Methodology for eGovernment Project Planning. In Prog. The First International Conference on Research Challenges in Information Science – Reis 2007 Sponsored by ICEE: 97–106, April 23–26, Overzazate, Morocco, 2007
7. Grönroos, C. (2000). *Service Management and Marketing. A Customer Relationship Management Approach*. Chichester: Wiley
8. Shostack, G.L. (1984). *Designing Services that Deliver*. Harvard Business Review, 62: 133–139
9. Boudon, R. (1969). *Les méthodes en sociologie*. France: Presses Universitaires de France
10. Martinotti, G. (1998). Squinternet. Ordine e disordine nella società digitale. In: Borgogna, P. and Ceri, P. (eds.): *La tecnologia per il XXI secolo. Prospettive di sviluppo e rischi di esclusione*. Torino: Einaudi, 101–129
11. BRIDGES.org. (2005). The Real Access/Real Impact framework, for improving the way that ICT is used in development, from http://www.bridges.org
12. WEF and INSEAD. (2007). The Global Information Technology Report 2006–2007. Connecting to the networked economy. World Economic Forum and INSEAD
13. Sen, A. (1999). *Development as Freedom*. Oxford: Oxford University Press
14. Nussbaum, M. (1999). *Sex and Social Justice*. Cambridge: Cambridge University Press

Part III
Organizational Change and Impact of IT

A. Carugati[1] **and L. Mola**[2]

This section of the book covers topics related to the impact of IT on organizational change. After the recovery from the internet bubble, today's business players are beginning again to invest massively in technological innovation to increase their competitiveness. The world in which these new developments are taking place is however much more complex then it was only few years ago. The competitive landscape has been completely turned as businesses were laying low and the world was getting flatter [1]. It seems today that the phenomenon of continuous implementation emerged in connection with ERP implementations may not be limited to ERP cases but it is a much wider phenomenon that touches all IT investments of strategic relevance.

This situation requires a change in the mindset of practitioners and academics alike. To remain competitive businesses have to undergo processes of continuous improvements and therefore they need to stop thinking in terms of projects – with a defined goal and timeframe – and start thinking in terms of change processes. However, while much research has been conducted on IT related change, social, organizational, and behavioral consequences associated with information systems continue to present complex challenges to researchers and practitioners. Changing the mindset and learning from change management successes as well as failures is a survival imperative for any organization.

The purpose of this section is to present to the reader the latest studies carried out in the Italian business landscape. The topic is very wide and the papers featured in this section reflect the multiplicity of aspects and complexity found in the real world.

A total of eleven papers are presented in this section. The papers can be organized around different axes. The main ones regard the level of analysis from the individual (see Basaglia, Caporarello, Magni, Pennarola), to the group (see Francesconi), to the enterprise (see Casalino and Mazzone), to the market (see Carugati, Rossignoli, and Mola). Technology has also been studied as driver of change in the different time

[1]IESEG Business School Lille, France Aarhus School of Business, Aarhus Denmark, andreac@asb.dk
[2]Universita di Verona, Verona, Italy, lapo.mola@univr.it

perspectives of the organizations: the operational perspective (see Basaglia et al.; and Francesconi), the tactical perspective (see Benfatto and Del Vecchio) until we reach the strategic perspective (see Marchegiani and Vicentini).

All the works presented agree on the fact that new technologies play an important role in being drivers of change. Amongst the new technologies investigated we have mobile technologies (Basaglia et al.), health care pervasive technologies (Francesconi) architectural implementations of SOA in banks (Casalino and Mazzone), distributed process management (Pigni and Ravarini; Benfatto and Del Vecchio) and in electronic marketplaces (Carugati et al.), and Business Intelligence Systems (Rossignoli and Ferrari). All this new or evolving technologies bring new challenges to the practitioners and the researchers.

All papers agree on the fact that success in the process of adoption, adaptation and change does not lie only in the validity of the technological solution, but rather in the ability to manage the change process itself, the main pillars of which are the organizational learning of new techniques and new business models, the correct management of power, and the development of proper knowledge resources. (Minelli, Martone, Morelli).

In conclusion this section includes compelling works that challenge our thinking regarding taken-for-granted assumptions, models, and research practices on the link between new and emerging technology and new forms of organization. They provide valuable inputs for the change agents – researches and practitioners alike – of tomorrow.

Reference

1. Friedman, T. L. (2006). *The World is Flat*, Penguin Books, London

Individual Adoption of Convergent Mobile Technologies In Italy

S. Basaglia, L. Caporarello, M. Magni, and F. Pennarola

Abstract The present study integrates the technology acceptance and convergence streams of research to develop and test a model of individual adoption of convergent mobile technologies. Adopting structural equation modeling, we hypothesize that relative advantage, effort expectancy, social influence and facilitating conditions affect directly individual attitude and, indirectly the intention to use convergent mobile technologies. The model explains a highly significant 53.2% of the variance for individual attitude, while individual attitude accounts for 33.9% of the variance in behavioral intention.

Research Model and Hypotheses Development

This paper presents a model of individual adoption of convergent mobile technologies. According to this paper, a convergent mobile technology is an IT artifact that (1) converges in complements, and (2) enables different features (i.e., personal information management, music management, image management, etc.), and services (voice, data transfer, internet browsing, mobile gaming, etc.).

Consistent with the theoretical background of previous research in the adoption field [1–5], we propose that attitude toward convergent mobile technologies directly influence the intention to use convergent mobile technologies. Moreover, we propose that attitude toward convergent mobile technology can be traced back to four individual beliefs about convergent mobile technology: relative advantage, effort expectancy, social influence, and facilitating conditions. Previous research on adoption points out the importance of attitudes toward a technology. In particular it is widely recognized both from a theoretical and empirical perspective that "intention to engage in a behavior is determined by an individual's attitude toward that behavior" [2]. Thus, applying this rationale to our contest we can derive that attitude

Università Bocconi, Milano, Italy, stefano.basaglia@unibocconi.it, leonardo.caporarello@unibocconi.it, massimo.magni@unibocconi.it, ferdinando.pennarola@unibocconi.it

toward convergent mobile technologies is positively related to its intention to use. Formally, Hypothesis 1: The more favorable the attitude toward convergent mobile technologies is, the greater the intention to use convergent mobile technologies.

Relative advantage. Relative advantage is defined as the degree to which a new IT artifact is perceived as being better than the alternative precursors [6]. The concept of relative advantage can be considered very similar to the definition of performance expectancy adopted by Venkatesh et al. [7]. However, relative advantage explicitly contains a comparison between the innovation and its precursor [8]. Several studies underscored that individuals are more likely to develop a positive attitude toward a new IT artifact if they belief that the new artifact could lead to concrete benefits in comparison with existing ones [8]. For example, Rogers [6] proposes a case study about the diffusion of mobile technologies in Finland. Results pointed out by Rogers [6] suggest the critical role of relative advantage for stimulating the adoption of mobile technologies. Moreover, Tornatzky and Klein [9] in their meta-analysis point out that relative advantage is the most salient driver in the process of technology adoption. Convergent mobile technologies have been developed in order to provide new features and services if compared with traditional mobile technologies (such as: e-mailing, multimedia applications), thus it can be perceived as a source of concrete benefits enhancing the individual attitude toward it. Therefore, we propose the following, Hypothesis 2: Relative advantage of convergent mobile technologies is positively related to its attitude.

Effort expectancy. According to Venkatesh et al. [7], effort expectancy is defined as the degree of ease associated with the use of the system. The conceptualization of effort expectancy can be traced back to the concept of "ease of use," which indicates the extent to which a person believes that using the system is effortless [10]. The importance of effort expectancy is critical in the introduction of a new technology. In fact, the adoption process of a new technology can be constrained and even fail when factors related to ease of use are not taken into account by technology designers [11]. Therefore, developers should take into account in a simultaneous fashion both the instrumental and the effortless side of the technology. Accordingly, Hypothesis 3: Effort expectancy of convergent mobile technologies is positively related to its attitude.

Social influence. Social influence is defined as the degree to which an individual perceives that important others believe he or she should use a new technology [7]. In the IS adoption domain has been developed a wide range of conceptualization of social influence. In particular it is possible to point out two main streams: on one hand, a normative approach (e.g., [3]), on the other hand, a social interaction approach [12, 13]. The normative perspective is dominant in the information systems literature [14] and it is based upon the "person's perception that most people who are important to her think she should or should not perform the behavior in question" [1]. Alternatively, the social information processing [15] states that individuals' beliefs and behaviors are shaped by the social context in which they are embedded. In particular, social information processing is based upon the assumption that the characteristics of a certain situation or object are constructed through social

interaction [15]. In our study we adopt the latter perspective (social information processing) for two main reasons: (1) Like other new consumer products, convergent mobile technologies are an "experience good" that consumer must be experienced to value. Convergent mobile technologies are far more ambiguous about their potential uses [16] if compared with other convergent devices (e.g., alarm clock). Because of that individuals are more likely to rely on others' opinions and beliefs. (2) Our research context refers to a non-mandatory setting. Indeed, the normative approach is particularly significant in mandatory settings [17]. Conversely, in a non-mandatory setting and in the early stage of adoption, informal networks play a pivotal role in influencing the individual process of technology adoption [6, 7]. In particular, opinions of social referents may enhance the individual's predisposition toward a new IT artifact. Formally, Hypothesis 4: Social influence is positively related to the attitude toward convergent mobile technologies.

Facilitating conditions. Relying on the definition provided by Venkatesh et al. [7] we consider facilitating conditions as the degree to which individuals believe that social resources exist to support them in interacting with convergent mobile technologies. Facilitating conditions have been widely analyzed in the workplace setting [7, 18] and have been conceptualized in terms of training and provision of organizational support. However, in our context, since we are not analyzing it in an organizational setting we suggest that the support may rely on the personal social network of each individual rather than on institutional support [6]. Formally, Hypothesis 5: Facilitating conditions are positively related to the attitude toward convergent mobile technologies.

Method

103 students from four Italian large universities voluntarily participated in this study. According with previous studies in this research stream the sample size could be acceptable [17]. According to Morris and Venkatesh [19], younger individuals are more likely to be the early adopter of a new technology. Therefore, since the convergent mobile technologies are at the early stage of its adoption, we decided to focus our research only on young individuals. In particular, respecting the cut-off of Brown and Venkatesh [20] we considered individuals under age 35. 47% of the respondents were male, and 53% were female. We used a standardized survey to gather the research data. Item scales utilized a five point, "strongly agree to strongly disagree" Likert response format unless differently indicated. In the following section we provide a general discussion of the psychometric properties displayed by scales, and an exemplar item. Intention to use was assessed through the three item scale developed by Venkatesh and Davis [4]. An exemplar item is "I intend to use the convergent mobile technologies in the next three months."

Individual's attitude was measured with four items adopted from Karahanna et al. [2]. An exemplar item is "Using the convergent mobile technologies is a good idea." Relative advantage was assessed by adapting a four item scale developed and

validated by Moore and Benbasat [21]. An exemplar item is: "Convergent mobile technologies increase my effectiveness in my daily activities." Effort expectancy was collected with four items adopted from Venkatesh et al. [7]. An exemplar item is "I would find the convergent mobile technologies easy to use." Social influence was assessed through two items from Venkatesh et al. [7], and two items from Lewis et al. [17]. An exemplar item is "People who are important to me think that I should use the convergent mobile technologies." The existence of facilitating conditions was measured with three items adopted from Venkatesh et al. [7]. An exemplar item is "My friends and colleagues are available for helping me with convergent mobile technologies difficulties." Control variable. In testing our model we included two control variables – gender and perceived knowledge – which prior research had suggested might affect the interaction between individual and technology. We decided to include gender because of mixed findings about the role of gender in the human-computer interaction domain. While some studies report that differences exist in the decision making process of technology adoption between men and women [22, 23], still other studies report no effects for gender on individuals' interaction with a technology [24]. The second control variable (perceived knowledge) assessed the individuals' belief that he/she has the knowledge necessary to use convergent mobile technologies. We controlled for this variable because from one hand previous research pointed out the influence of perceived knowledge on individuals' adoption process [20]. Conversely, other research points out that in the early stage of adoption individuals are more focused on the novelty of the product rather than on their ability to interact with it [6]. Perceived knowledge was assessed through two items adapted by Brown and Venkatesh [20]. In order to test our research model we followed the two steps strategy presented by Agarwal and Karahanna [24]. The first step focused on confirmatory factor analysis to assess the psychometric properties of adopted scales. During the second step, described in the following paragraph, we tested our research hypotheses focusing on the analysis of the structural relationships. For both the steps we adopted PLS, a latent structural equations modeling technique which fits particularly to our study because of its robustness with relatively small sample sizes [25]. The psychometric properties of the scales have been tested through items loadings, discriminant validity and internal consistency. We examined the internal consistency for all scales calculating the composite reliability index. Each scale displays an acceptable composite reliability coefficient ($> .70$) [26]. The factor analyses confirmed that all items loaded respectfully on their corresponding factor. Moreover, the square root of the average variance extracted (AVE) is higher than the interconstruct correlations. Overall, we conclude that the measures testing the model all display good psychometric properties.

The Structural Model

The results of the PLS analyses are presented in Fig. 1. The exogenous variables explain a highly significant 53.2% of the variance for individual attitude. In the

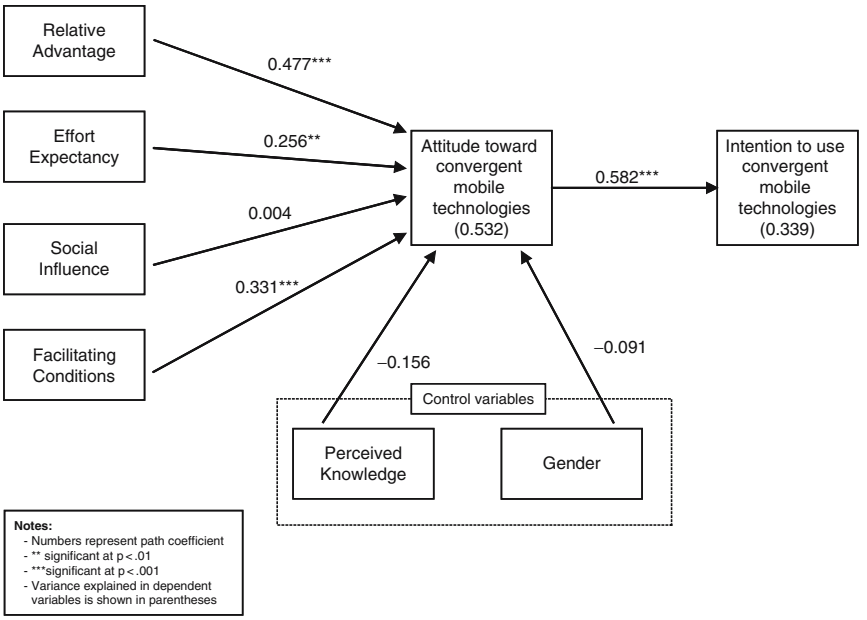


Fig. 1 PLS results

same time, individual attitude accounts for 33.9% of the variance in behavioral intention. The first hypothesis stating a positive influence of attitude on intention is strongly supported (coeff. $= 0.582$ p < 0.001). As noted above, the second hypothesis, positing that the relative advantage has a positive influence on attitude toward convergence (coeff. $= 0.477$ p < 0.001) is strongly supported. Further, hypothesis 3, predicting that effort expectancy has a positive influence on individual attitude is supported too (coeff. $= 0.256$ p < 0.01). Hypothesis 4 considering the effect of social influence on individual attitude is not supported. However, hypothesis 5 positing that facilitating conditions have a positive influence on attitude toward convergent mobile technologies is strongly supported (coeff. $= 0.331$ p < 0.001).

Discussion and Implications

Our results both provide some support for the overall model and some unexpected relationships. In particular, these results underscore the important role played by relative advantage. This result underscores the utilitarian perspective in shaping individuals' attitude toward a new technology [2]. Moreover, it is counterintuitive that social influence does not have any significant impact on individuals' attitude toward a new technology. This aspect can be traced back to the controversial role of social influence in studying the process of technology adoption. The lack of significance can be explained by: (1) our sample is composed by young individuals.

Indeed, other studies (e.g., [19]) have found that social influence is less significant for younger people. (2) The convergent mobile technologies in Italy are at the first stages of diffusion process. During the first stages the early adopters are driven by a better instrumental consciousness and are less sensitive to informal channels of influence [6]. This consideration is consistent with Venkatesh et al. [7] explanation for the equivocal results reported in the literature. In particular, they point out that social influences change during the overall diffusion process. Our results do not refuse the importance of social environment. In fact, as noted above, the social environment is not significant from an influential point of view but plays a fundamental role as a locus for supporting individuals in their potential experience of their interaction with the convergent mobile technologies. This means that for developing a positive feeling toward convergent mobile technologies individuals should belief that they can rely on the technical support of their informal network. This reinforces the utilitarian point of view previously underlined. Finally, the positive influence of effort expectancy confirms the critical role played by the technology ease of use. In fact, individuals who do not perceive a high cognitive effort in interacting with a new technology are more likely to develop positive attitude toward the innovation.

References

1. Fishbein, M. and Ajzen, I. (1975). *Belief, attitude, intention and behavior: An introduction to theory and research*. Reading, MA: Addison-Wesley
2. Karahanna, E., Straub, D.W., and Chervany, N.L. (1999). Information technology adoption across time: A cross-sectional comparison of pre-adoption and post-adoption beliefs. *MIS Quarterly*, 23(2), 183–213
3. Venkatesh, V. (2000). Determinants of perceived ease of use: Integrating control, intrinsic motivation, and emotion into the technology acceptance model. *Information Systems Research*, 11(4), 342–366
4. Venkatesh, V. and Davis, F.D. (2000). A theoretical extension of the technology acceptance model for longitudinal field studies. *Management Science*, 46, 186–204
5. Ajzen, I. (2001). Nature and operation of attitudes. *Annual Review of Psychology*, 52(1), 27–58
6. Rogers, E.M. (2003). *Diffusion of Innovations* (fifth edition). New York: The Free Press
7. Venkatesh, V., Morris, M.G., Davis, G.B., and Davis, F.D. (2003). User acceptance of information technology: Toward a unified view. *MIS Quarterly*, 27(3), 425–478
8. Karahanna, E., Ahuja, M., Srite, M., and Galvin, J. (2002). Individual differences and relative advantage: The case of GSS. *Decision Support Systems*, 32, 327–341
9. Tornatzky, L.G. and Klein, K.J. (1982). Innovation characteristics and innovation adoption implementation: A meta-analysis of findings. *IEEE Transactions on Engineering Management*, 29(1), 28–44
10. Davis, F.D. (1989). Perceived usefulness, perceived ease of use, and user acceptance of information technology. *MIS Quarterly*, 13(3), 318–340
11. Orlikowski, W. (1992). The duality of technology: Rethinking the concept of technology in organizations. *Organization Science*, 3(3), 398–427
12. Fulk, J. (1993). Social construction of communication technology. *Academy of Management Journal*, 36(5), 921–951

13. Burkhardt, M.E. and Brass, D.J. (1990). Changing patterns or patterns of change: The effects of a change in technology on social network structure and power. *Administrative Science Quarterly*, 35(1), 104–128
14. Agarwal, R. (2000). Individual acceptance of information technologies. In R. W. Zmud (Ed.), *Framing the domains of IT management: Projecting the future from the past* (pp. 85–104). Cincinnati: Pinnaflex Educational Resources
15. Salancik, G.R. and Pfeffer, J. (1978). A social information approach to job attitudes and task design. *Administrative Science Quarterly*, 23(2), 224–252
16. Kraut, R., Mukhopadhyay, T., Szczypula, J., Kiesler, S., and Scherlis, B. (1999). Information and communication: Alternative uses of the internet in households. *Information Systems Research*, 10(4), 287–303
17. Lewis, W., Agarwal, R., and Sambamurthy, V. (2003). Sources of influence on beliefs about information technology use: An empirical study of knowledge workers. *MIS Quarterly*, 27(4), 657–678
18. Gallivan, M.J., Spitler, V.K., and Koufaris, M. (2005). Does information technology training really matter? A social information processing analysis of coworkers' influence on IT usage in the workplace. *Journal of Management Information Systems*, 22(1), 153–192
19. Morris, M.G. and Venkatesh, V. (2000). Age differences in technology adoption decisions: Implications for a changing work force. *Personnel Psychology*, 53(2), 375–403
20. Brown, S.A. and Venkatesh, V. (2005). Model of Adoption of Technology in Households: A Baseline Model Test and Extension Incorporating Household Life Cycle. *MIS Quarterly*, 29(3), 399–426
21. Moore, G.C. and Benbasat, I. (1991). Development of an instrument to measure the perceptions of adopting an information technology innovation. *Information Systems Research*, 2(21), 192–222
22. Venkatesh, V. and Morris, M.G. (2000). Why don't men ever stop to ask for directions? Gender, social influence, and their role in technology acceptance and usage behavior. *MIS Quarterly*, 24(1), 115–139
23. Ahuja, M.K. and Thatcher, J.B. (2005). Moving beyond intentions and toward the theory of trying: Effects of work environment and gender on post-adoption information technology use. *MIS Quarterly*, 29(3), 427–459
24. Agarwal, R. and Karahanna, E. (2000). Time flies when you're having fun: Cognitive absorption and beliefs about information technology usage. *MIS Quarterly*, 24(4), 665–694
25. Chin, W. (1998). Issues and opinions on structural equation modeling. *MIS Quarterly*, 22(1), 7–10
26. Fornell, C. and Bookstein, F. (1982). Two structural equation models: Lisrel and pls applied to consumer exit-voice theory. *Journal of Marketing Research*, 19(3), 440–452

Organizational Impact of Technological Innovation on the Supply Chain Management in the Healthcare Organizations

M.C. Benfatto and C. Del Vecchio

Abstract The methodology of global management of the distribution process, i.e., the Supply Chain Management (SCM), has gained a high level of diffusion in modern organizations. At the moment the supply chain plays a critical role and constantly challenges the health care domain. In this field, the SCM approach intends to manage the whole specific goods supplying process, drugs' assemblage and distribution and assistance to patients in the cure administration. This paper examines some of the key considerations and opportunities for SCM solutions in the field of Health specific goods and focuses the benefits of an integrated management of the processes and the main actors involved. The analysis also shows the difficulties in the implementation of ICT solutions in the health care supply in order to improve speed of execution goods and service costs and offered quality.

Introduction

In order to optimize performances, the Supply Chain must be implemented through integrated solutions. However the peculiar dynamics of the health organization and the concerned quasimarket make this difficult: materials have to be in place before the need rises, drugs expire, distribution is spread out in the hospital units and among personalized cures, so that each and every end-user might be considered as a single case.

On the one hand, the end user, the patient/final client, does not accept delays or unavailability of a drug he/she benefits. On the other hand, the health demand is mostly indirect since doctors outline patients' pharmaceutical needs.

Even if in delay with respect to the dynamics of pharmaceutical retailers (14,000 in Italy, destined to increase in number, in consequence of market liberalization, and to challenge the logistical companies, which have to face their geographic distribution), also health organizations manage considerable pressures to innovate the whole

Università LUISS – Guido Carli, Roma, Italy, mcbenfatto@luiss.it, cdelvecchio@luiss.it

supply chain, and to rationalize the entire provision, from the central warehouse to each hospital unit.

To this respect, technical and organizational innovation in the supply chain and the integrated management of single unit warehouses, allows the decrease of the time needed to re-integrate units' storage level and the reduction of drugs' stock and expired or short-running stocks [1]. However the economical impact of stock rationalization is not the only advantage deriving from the adoption of these solutions, but a greater importance is associated to the benefits related to errors and inaccuracy, identification of the clinician who have administered the drug, tracing of the administered therapies, supervision on drugs interaction, compatibility and counter-indications.

In many Italian health experiences the tendency is to emphasize the importance of supplying rationalization and integrated logistics. Moreover, in some cases, new technologies have been tested to guarantee not only the supplying but also the traceability of drugs and medical devices in order to monitoring and safeguarding cure administration and accuracy.

Literature Review

According to Ferrozzi and Shapiro [2], the term logistics is defined as the planning of processes, organization and management of activities aimed to optimize the flow of materials and related information inside and outside the organization.

The Supply Chain Management represents the last evolution of logistics management. This approach recognizes that nowadays an integration which takes place within the organization is not enough because every company is part of a network of relationship between many different entities which integrate their business processes, both internally and externally [3]. From this point of view it seems necessary to involve the whole network where the organization is immersed and to integrate processes and activities which produce value in terms of products and services for the end-consumer [4, 5].

It is evident that the technological revolution – today leaded by Internet – accentuates these processes [6, 7]. It enables a low cost and pervasive capacity of interorganization connections, and so creates new opportunities of collaborations, both from the organizational, managerial and operative point of view. It also permits a more interactive connection with clients – oriented toward the optimization of the demand and the Supply Chain – and its own suppliers, in order to experiment new business models, that are characterized by an interorganizational integration of systems and processes [8].

In the hospital domain, the logistical area should be one of the most integrated ones: producers, depositary, distributors, logistic operators and inside pharmacy should share the same practices and tools for efficient and fast communication.

Thanks to technological innovation, in many hospitals it is possible to think over processes, and consequently to realize this integration.

Even when the idea of "Just in Time" (typical of the industrial sector logistics) cannot take place, we assist to a punctual definition of goods consumption and devices' monitoring that allows supply policies to be more effective and favorable, with significant consequences in terms of time and expense reduction.

Alessandro Perego [9] identifies at least three evolutions in progress in the Italian health logistics. The first one derives directly from Business concentration among a few middle distributors: 300 warehouses located in Italy and destined to decrease and to become more efficient, thanks to informatization, automation and rationalization of the whole distribution cycle. In organizational terms this means: mechanisms of automatic identification of products, rationalized warehousing and transportation, final destination attributed through electronic systems (picking and handling). The strengthening of interface processes between distributors and pharmacies represents the second trend and it is esplicitated in the computational management of orders, which allows real time replies and until four deliveries per day. The third evolution deals with the RFID technology (Radio Frequency Identification), which will be of fundamental importance in guaranteeing the traceability of drugs and the constitution of a central Database, as prescribed by recent legislative dispositions.

Tendencies

In the scenario outlined above, the capacity of coordinating the internal functions of the business and the network of the external actors that are involved in the production process, is configured like a strategic asset finalized to satisfy demand's requests, while maintaining qualitative performance and efficiency. The concept of Supply Chain Management, arises from these exigencies, differing from traditional logic of management and control of processes implemented along the logistic chain as for four fundamental aspects:

- A substantial cohesion of the intentions among all the actors of the network.
- An accentuated orientation to sharing all the strategic decisions.
- An intelligent management of all the materials' flow.
- An integrated approach to the use of information systems as means of support to the planning and the execution of all the processes along the Supply Chain, as direct consequence of the aspects previously analyzed.

The introduction of integrated Logistics solutions leads to a meaningful change in the traditional hospital business model, from several perspectives: operatively, organizationally/managerially and culturally. This revolution determines the improvement of efficiency and, at the same time, generates a strong interdependence among the hospital units [10]. What is more, all the functioning of the organization is facilitated by the introduction of automatic praxis – connected to standard behaviors – that the system can accomplish and support.

However the aspect we must consider in the standardization of processes is that the health service, which is a naturally client-oriented service, cannot be simply

inserted in a structured workflow; it is always necessary to consider this peculiarity when the management plans the information and operative flow and the implementation of technology supports [11].

All the logistic chain would gain in terms of integration, on different levels: functional, operative, informative and managerial.

The economic aspects are not the only benefits deriving from the use of organizationally and technologically integrated solutions, because more important are the benefits brought about by the reduction of risk of errors and so of every predictable event that leads to an inappropriate use of the drug or to severe danger for patient's life, due to the assumption of not prescribed drugs [12].

In Italy, it is estimated that healthcare errors weigh on the 4% of hospital admissions. Since the annual admissions are 8 millions, this means that 320,000 patients suffer, every years, from damages that could be prevented. The deaths were between 30,000 and 35,000 in 2002, 6% more than the deaths in 2000 (Health Ministry, Technical Commission on clinical risk, DM 5 March 2003; CINEAS, University Consortium for Assurance Engineering, ASI 2002).

Due to these data, a new sensibility, with respect to clinical errors, has emerged so that innovative technologies have been experimented to improve safety in drugs administration and medical devices usage. A radical change can be tracked in the experimentation of single-use drugs and the introduction of Bar Code and RFID technology. These new devices open up to a new concept of patient's care path. In a systemic view of the therapy, the single-use drug and the bar-code innovate the management of the hospital pharmacy; in fact all the drugs coming from the logistic provider might be unwrapped from the usual multiuse package and re-assembled for single use, then destined to the pharmacy of a specific unit.

Moreover each single-use package is characterized by a bar-code associated to an electronic patient record with analogous bar code and to the electronic bracelet worn by the patient, which connects automatically him/her to the corresponding pharmacological/clinical therapy.

The RFID, on the other hand, is based on radio frequency technology and serves to identify, trace and find pharmaceutical products and devices (electric biomedical equipment) in the hospital units. Data can be delivered in both directions depending on the transponder characteristics and stored in a memory device. It is easy, then, to figure out the potential of this technology solution, especially as a storage of fundamental information like, for instance, the monitoring of life parameters, drug therapy, laboratory examinations and recognition of the clinician involved in the cure process.

Case Studies

As concerns integrated logistics solutions, Viterbo ASL represents one of the most advanced experiences in Italy. Thanks to a sharp management the ASL has started a project of radical organizational change in the supplying cycle.

Viterbo local health unit provides care through complex and simple units on the basis of three different services: hospital service, territorial service and administrative service.

The current ASL supplying/logistics function is divided in 5 different areas: products, goods, diagnostics and systems, services and e-procurement. The e-procurement area is primarily responsible for: central orders management and accounting for all the sanitary and nonsanitary goods; reassessment and management of goods and suppliers catalogues; start-up and co-ordination of the electronic Market-place based on product categories and suppliers accredited by Consip and Lazio Region; innovative projects in the logistics field.

The most interesting innovation has been realized by introducing two different information platforms, which have determined a transition from traditional informative vertical system to the concept of integrated systems. The first platform has been implemented to centralize outsourcing logistics. The second platform, instead, aims to realize a complete decentralized procurement between ASL units/wards and external suppliers.

The two planned platforms are mutually aligned: the traditional central software AS400 manages the single stocks catalogued per product/price/supplier. It is also integrated with ward's software MAGREP, which is utilized by each ward chief nurse.

The use of these platform, on the one hand, has taken to an information and organizational integration, on the other hand it has also met difficulties and constraints.

What management has observed is that the involvement of the chief nurse as responsible for the decentralized platforms has generated new cultural challenges. To promote change acceptance, the logistics management has started a training program, which was fundamental to make professionals see what is changing not as a danger to their professional autonomy but as means of a way to improve their jobs' effectiveness, the unit's efficiency and, lastly, the improvement of patients' health.

As second strategic decision to be implemented in the future, with the purpose of higher integration in the upstream supply chain, Viterbo ASL aims to create an "E-procurement" complex organizational unit, mainly divided into two simple units: supplying and logistics.

The decision of separating the two activities points at exalting the role of logistics and, at the same time, rationalizing processes along the supply chain.

We expect that, in the long-term, this strategy will lead to a more comprehensive downstream integration of the supply chain, as means of higher awareness about the risks that the manual management of this process involves, as well as the problems related to the patient treatments.

To this respect, some hospitals are outlining a new frame of best practices characterized by absolutely innovating contents. It is, for instance, the case of Molise Region (Italy), whose government has launched a project called "Health Information Systems for internal management of pharmaceutical resources." It consists of an information system that manages drugs in the hospital environment through real time traceability, from the order request to the administration to the patient. This project is aimed to reduce the time necessary to reach the end-user and as means of organizational-processing integration, thanks to the support of technology.

Moreover the new procedures qualify the warehouse as a temporary location and reduce stock costs by means of an ongoing supervision of stock inventory.

Another best practice is represented by Florence ASL (Italy). Thanks to a web platform, the Region leads the pharmaceutical distribution on the territory. In particular the organizational model chosen by the region consists of supervising first the purchase of pharmaceutical products by the local health organizations then the delivery to the main distributor, which afterwards provides for the delivery to the other actors of the chain. This setting postulates the supervision of both the products handling in the intermediate distribution chain and, at the same time, the supply towards the patients.

Despite these examples of excellence, the transition from the term depository to the concept of integrated chain is still incomplete. Against the desirable benefits it is needed to counterweight a hard "mind-changing."

A particularly evident effect in the introduction of ICT in the Health domain is detected in the Human resources Management; Cicchetti [13–15] argues that the use of new information and communication technologies in the clinical processes has accelerated the phenomenon of individual competences fragmentation and amplifies health organizations' need to deepen personnel specialization, not only in connection with patients' necessities, but also with respect to the devices usable to cope with particular medical or administrative issues [16]. It has also generated new cultural challenges [17].

We argue that organizational change must be supported primarily by the hospital management, then accepted by units' chief nurses and by the clinicians involved in the goods administration process [18, 19].

References

1. Kim, S.W. (2007). Organizational structures and the performance of supply chain management. *International Journal of Production Economics*, 106(2), 323–345
2. Ferrozzi, C. and Shapiro, R. (2001). *Dalla logistica al supply chain management*. ISEDI, Torino
3. Jespersen, B.D. and Skjott-Larsen, T. (2005). *Supply Chain Management in Theory and Practice*. Copenhagen business school press, Copenhagen
4. Simchi-Levi, D. and Kaminsky, P. (1999). *Designing and managing the Supply Chain*. 1st Edition. McGraw-Hill, London
5. Thomas, D.J. and Griffin, P.M. (1996). Coordinated supply chain management. *European Journal of Operational Research*, 94, 1–15
6. Baraldi, S. and Memmola, M. (2006). How healthcare organisations actually use the internet's virtual space: A field study. *International Journal of Healthcare Technology and Management*, 7(3–4), 187–207
7. Benedikt, M. (Ed.) (1991). *Cyberspace*: *First Steps*. MIT, Cambridge
8. Reed, F.M. and Walsh, K. (2000). Technological innovation within Supply Chain. ICMIT 2000. Proceedings of the 2000 IEEE International Conference, Vol. 1, 485–490.
9. Perego, A. (2006). L'informatica e l'automazione collegano farmaco e paziente. *Monthly Logistics*, 52–53

10. Cousins, P.D. and Menguc, B. (2006). The implications of socialization and integration in supply chain management. *Journal of Operations Management*, 24(5), 604–620
11. Atun, R.A. (2003). Doctors and managers need to speak a common language. *British Medical Journal*, 326(7390), 655
12. Atkinson, W. (2006). Supply chain management: new opportunities for risk managers. *Risk Management*, 53(6), 10–15
13. Cicchetti, A. (2004). Il processo di aziendalizzazione della sanità in Italia e gli 'ERP sanitari' di domani. *Sviluppo e organizzazione*, 196, 102–103
14. Cicchetti, A. and Lomi, A. (2000). Strutturazione organizzativa e performance nel settore ospedaliero. Sviluppo e organizzazione, 180, 33–49
15. Cicchetti, A. (2002). L'organizzazione dell'ospedale: fra tradizione e strategie per il futuro, 1st Edition. *Vita e Pensiero*, Milano
16. Cicchetti, A. and Lomi, A. (2000). Strutturazione organizzativa e performance nel settore ospedaliero. *Sviluppo e organizzazione*, 180, 33–49
17. Boan, D. and Funderburk, F. (2003). *Healthcare quality improvement and organizational culture*. Delmarva Foundation Insights, November
18. Earl, M.J. and Skyrme, D.J. (1990). Hybrid Managers: What should you do? *Computer Bulletin*, 2, 19–21
19. Shortell, S.M. and Kaluzny, A.D. (1999). *Health Care Management: Organization Design and Behavior*. Delmar Learning, Clifton Park (NY)

E-Clubbing: New Trends in Business Process Outsourcing

A. Carugati[1], **C. Rossignoli**[2], **and L. Mola**[2]

Abstract The role of IT in the make-or-buy dilemma represents one of the most important topics in the IS research field. This dilemma is becoming increasingly more complex as new players and new services appear in the market landscape. The last few years have witness the emergence of electronic marketplaces as players that leverage new technologies to facilitate B2B internet-mediated relationships. Nowadays these players are enlarging their services, from simple intermediation to include the outsourcing of entire business processes. Using a longitudinal qualitative field study of an e-marketplace providing the outsourcing of the procurement process we develop an in depth understanding of the role of these extended intermediaries in the shaping of the collaborative practices among different organizations. The paper proposes that, as marketplaces engage in complex process outsourcing practices they generate new collaborative dynamics among participants that begin to privilege the trusted small numbers rather that the convenience of the access to the entire, but unknown, market. The participants see the marketplace as an exclusive club whose belonging provides a strategic advantage. While profiting from this unintended consequence, the e-marketplace assumes the paradoxical role of an agent who heightens the fences of the transactions instead of leveling them. Based on these first results we conclude with implications for the technology mediated Business Process Outsourcing (BPO) practice.

Introduction

The make-or-buy dilemma has been widely analyzed in the IS field. The reason why the literature on this subject is so prolific is because information technology

[1]IESEG Business School Lille, France Aarhus School of Business, Aarhus Denmark, andreac@asb.dk
[2]Universita di Verona, Verona, Italy, cecilia.rossignoli@univr.it, lapo.mola@univr.it

(IT) allows the physical separation of different activities and also because the IT function itself was one of the first business areas to be outsourced constituting a multibillion dollar business.

While only a few marginal business activities were initially outsourced for the sole purpose of improving efficiency and controlling costs [1], in the 1990s most organizations started to outsourcing entire "core" company functions, including in some instances core-business processes [2].

The emergence of the internet as a global infrastructure for electronic exchanges has further increased the outsourcing services. New players – known as electronic marketplaces – entered the scene as the mediators of virtually any transaction. Covisint.com, for example, represents an emblematic case of strategic use of the internet in order to manage and control the relationship among many actors involved in the automotive industry value chain. The main aim of e-marketplaces was to leverage the IT infrastructure to put in contact a large number of suppliers and buyers. The business model was to decrease buyers' and suppliers' transaction costs while charging a fee for the service.

While much has been written on marketplace's technologies and functionalities and on their relations to the member companies, little has been written on the role that marketplaces have in the shaping of the behavior of the member organizations among themselves. In particular the inter-organizational behavior has never been studied longitudinally as the services provided by the marketplaces evolve over time.

The focus of this research is on the way in which electronic intermediaries affect – through their evolving services and supporting technologies – the governance structure among the actors involved in the value chain. Specifically this paper investigates the role played by IT-supported marketplaces in shifting the organizational boundaries and behaviors of companies in the continuum between hierarchically or market-based governance structures [3].

Electronic marketplaces – as mediators among business partners – re-design the procurement process and generate new collaborative dynamics among participants. Marketplace members, following a drifting trajectory, begin to privilege a new form of coordination, the close market, which is surprisingly preferred to the access to the entire market – which is normally the reason to become member of a marketplace. A case study of an e-marketplace in the food industry, analyzed from the point of view of the marketplace, suggests that as more complex services are proposed the participants begin to prefer an exclusive access to the technology and to the network. The technology furnished by the marketplace is seen as a source of strategic advantage and therefore its accessibility has to be protected. While profiting from this unintended consequence, the e-marketplace changes its role from being an agent who levels the access to becoming the involuntary instrument of gate keeping.

This paper is structured in the following way: first the theoretical discourse on electronic intermediation is presented, then we present the research method and research site. Finally the analysis and the discussion are presented.

Current Views on e-Marketplaces and Transaction Cost Theory as a Guiding Framework

As presented in the previous section we are interested in understanding the role of a marketplace in B2B transaction as the level of service proposed change. With this purpose it is interesting to catalogue B2B e-marketplaces according to the level of service they propose. The first marketplaces – first generation architecture – are open electronic platforms enabling transactions and interactions between several companies [4]. The primary purpose of first-generation e-marketplaces was the creation of a more competitive market and friction-free commerce [5].

For the purpose of creating a more sustainable business model, some e-marketplaces are oriented towards the so-called second-generation architecture, which includes the management of the entire transaction, from the on-line definition and development of orders to logistics management, using the tools made available by the virtual marketplace [6]. However, the development of these portals is crippled by these services being too pricey, so that in some instances the number of participants is too low to guarantee survival of the platform. The gist of the problem is that a high number of members should be involved to reach critical mass. The problem resides in the mismatch between the business model based on large numbers and the service model based on high level and high complexity.

Christiaanse and Markus [7] call these second generation e-marketplaces for *collaboration* marketplaces. They "act more as purchasing process facilitators, enabling interorganizational systems integration and providing specialized supply chain collaboration capabilities" (ibid p. 1). In this view, the use of an e-marketplace as a tool or place for managing transactions, results in the creation of decentralized business structures, which do not depend on the physical boundaries of a given company. In fact, the end point seems to be the digital integration of all phases involved in the value chain (procurement, production, distribution and sale), irrespective of the fact that these may be controlled by a leading company or by independent entities specialized in various sectors.

Considering the shift between first and second generation of marketplaces, the integration process impacts the organizations in the following two ways:

1. Restructuring and changing of preexisting processes and functions, due to the adoption of ICT.
2. Involvement of new players in the supply chain and subsequent need for companies to establish and manage new relations.

In this scenario, the strategic choice between make or buy is no longer about a single product or a specific production factor, but it is a decision that concerns a set of services structured around different activities grouped in a particular process.

Outsourcing in fact, can be defined as a process of e-nucleation of either strategic or marginal activities and in allocation of these activities to a third party. In

an outsourcing operation is therefore created a partnership between at least two entities: the company wishing to delegate an activity and a specialized company able to provide such activity.

The outsourcing phenomenon has often been explained in the literature by referring to the Transaction Cost Theory (TCT) [1, 8, 9]. The main reason behind the development of TCT has been to create a framework to better understand the "*comparative costs of planning, adapting, and monitoring task completion under alternative governance structures*" [10], The basic element in TCT is the transaction, which "*occurs when a good or service is transferred across a technologically separate interface*" [11]. Transactions costs change depending on many reasons (opportunisms, uncertainty/complexity, small numbers and bounded rationality). It is therefore a managerial task to compare the production and transaction costs associated with executing a transaction within the firm (insourcing) versus the production and transaction costs associated with executing the transaction in the market (outsourcing). If decision makers choose to use the market, they must then determine the appropriate type of contract to use.

According to TCT the changes in governance mechanism – market or hierarchy – depend on the relative weight between the cost of the market and the organizational incurred costs. Coase [8] suggested that enterprises and markets are alternative, although complementary, governance methods of transactions but the methods used to process information affect the comparative efficiency of organizational forms [1].

Market and hierarchy represent two opposite ends of the same *continuum*, inside which different configurations of *quasi market* and *quasi organization* can be found. From an organizational design standpoint, the problem lies in the identification of an efficient boundary between interdependent organizations and, within the same organization, between different organizational units.

Based on this perspective, the purpose of an organization is to manage and balance the economic transactions between its members or with other organizations. The objective is to reach a form of governance that minimizes coordination costs. The choice of the most efficient form of transactions governance therefore is connected with the form that contains both production and transaction costs [12]. Hence, the *make* (i.e., procure internally) – or – *buy* (i.e., procure externally) dilemma.

Choen and alii [13] suggest that TCT is a better explanatory theory for complex externalization processes, especially when the reasons behind such choices go beyond the need to cut down production costs. This reasoning seems to be in line with drivers for service selection. Therefore, while Christiaanse and Markus [7] propose multiple theories for making sense of collaboration marketplaces, for the purpose of this article TCT remains the most relevant framework due to the fact that the investigated phenomenon, the procurement process outsourcing, is more complex than cost cutting consideration and due to the fact that we consider the evolution from mediation to collaboration rather than only collaboration marketplaces. Finally, such theory explains the different outsourcing options that can be found in all procurement processes.

Research Method and Case Analysis

The method use for the analysis is a case study research method, useful in order to examine a phenomenon in its natural settings. The following case study concerns an Italian e-marketplace.

Starting in January 2006 we conducted six month field study of the AgriOK Marketplace, using primarily, qualitative data collection techniques.

We established our relationship with AgriOK after observing the content of their Web Portal and after having had contacts with some of the participant to the network.

As nonparticipant observers we spent 2–3 days a week 5 h a day in the AgriOK headquarter, recording our observations.

Detailed observations were supplemented with 10 in. depth interviews with AgriOK managers. I addition we analyzed the printed documentation and then intranet based documentation archives. We studied also the structure of the website and the procedures used for the development of the main services.

To understand the nature and evolution of the dynamics among participants, we have conducted a deeper analysis focused on understanding how participant really used the marketplace and the drivers conducting their decision in adopting or refusing services and transactions

AgriOk is an e-marketplace in the agricultural and food sector specialized in dairy products. The e-marketplace was created in 2000, and today counts about 1,500 participating enterprises and over 250 subscriber suppliers.

The companies participating in the AgriOK's network are usually small/medium enterprises operating in the agricultural and food industry within the Italian territory and, in particular, in central and North Italy.

The mission of the AgriOk is:

- To guarantee traceability and quality of the products in the supply chain
- Develop a technological environment which might provide consultancy services to participants supporting them in the procurement process

Nowadays the e-marketplace enables a strong integration of the supply chain, from suppliers of raw materials (milk and agricultural products) to food processing companies, working exclusively with ICT and creating a real strategic network capable of competing at a global level.

The services offered can be categorized into two macroareas. These are: standard services for the supply chain and additional services.

Standard services. The purpose of the first type of services is to give to participants support to their activities through an easy, effective and consistent connection within the supply chain.

Customized service. This second group of services consists in providing the ability to identify users accessing to a given service, adjusting the response accordingly. Depending on the identity of the users accessing it, the portal provides sector-specific, technical and marketing information and links to local businesses. In this

category are also provided Information services to screen useful products to correctly manage the entire supply chain.

All those services are entirely managed through the website. Moreover, AgriOK automatically forwards requests to suppliers companies and delivers the received offers to buyers. At the end of this process, buyers can select the most advantageous offer or reject all offers, if they so wish. Thanks to this type of service, costs and time of transmission of requests are minimal, since faxes, couriers or even traditional mail services are no longer required.

At the beginning of the activity the purpose of AgriOk was to expand its business, both vertically, along the entire supply chain, and horizontally, towards the fruit-and-vegetable, wine and meat sectors. The CEO of the Portal said that:

> *"In this way, it is possible to provide the companies of the sector with outsourceable support, thus creating a vertical integrated value chain and therefore allowing immediate product traceability and other benefits …The main goal in our mind was to create the new Amazon.com of the diary industry".*

The initial business model was designed in a traditional way, where AgriOk would collect a percentage based fee on each transaction done throughout the e-marketplace.

Since the early stage of the life of the marketplace the transactions were very few compared to the access and the requests of information about the products and the characteristics of the vendors and sellers.

According to this trend the top management of the portal decided to change the business model, implementing a set of services that could interested the participants. As one of the top executives in AgriOk put it:

> *"We understood that our clients were not ready yet for the new economy. An Internet-base transaction platform was too far from their way of thinking. The agricultural industry in fact is not yet familiar with ICT. Framers prefer face to face agreement in stead that virtual contract. Internet was considered good as communication media, so we started providing a portfolio of simple services to those who decided to join the portal".*

The new business model was set on the base of fixed fee for subscriptions linked to the services desired. Nevertheless, in order to reach the critical mass, the management of AgriOK decided to offer some services for free. These ones were a collection of advices given by a group of experts, news and event of the sector, detailed information about fairs.

The services available as subscriber were also customized. A software was able to identify users accessing to a given service, adjusting the response accordingly. Different types of services were setup to achieve different goals:

Marketing services. These services were thought for those participants who were looking for tools in order to support their commercial activities. The portal offers

a special area called "virtual shop window" where the participants can show and advertize their products and make a virtual visit of others firms of this area.

Legal services. This kind of services provides a continuous updating and interpretation of the requirements given by local, national and European authorities regarding quality and process management in the food industry.

Consultant and assistance services. The experts of AgriOK are available to offer their assistance to help participants in order to solve problems connected with adversity (parasites, insects, epidemics) or to solve questions of enrichment and dressing earthly.

Traceability services. These are one on the most requested services required by participants to the e-marketplace. Thanks to the registration to the portal all the firms belonging to the value chain can recognize every change made by the product in any firm transit.

Screening, selection and ranking of suppliers. The portal establishes a list of requirements of a number of possible suppliers who can satisfy the needs of supplying of the participants. The participant can outsource the whole procurement process. AgriOK offers e-catalog e-scouting services supporting the transactions and payment. Throughout the marketplace participants can decide which activity of the procurement process to outsource and which ones to maintain in house.

As the number of services and their complexity increased the participants did not augment the transactions in the marketplace as it was expected but rather they began to change their behavior. The management of AgriOk began to face requests that were showing a new protectionist behavior emerging from the members respect to the nonmembers. One executive reported this change:

> *"Once the participants started using those services more strategic for their business, they began asking guarantees about the reliability of the new potential entrants. We were supposed to be not only a virtual bridge between clients and suppliers or a service provider, but a real authority in charge of the good service of the network".*

The management decide to accept these requests and established new rules that must be respected to entry and participate to the network. Admission barriers were set based on ethic, politic, trust principles decided by the marketplace as new emerging authority. As the CEO said:

> *"… in a certain way we can consider ourselves as a bouncer on the door of the club".*

Initially, AgriOk's customers would only use the services connected with the marketplace and therefore would adopt the platform for the direct sale/purchase of goods, thus reducing intermediation costs and keeping transaction costs to the bare minimum. Today, AgriOK's technological platform is not just used to reduce costs, but first and foremost to improve and enable sharing of information along the entire supply chain, thus creating a real strategic virtual group capable of competing at an international level both with emerging countries and large multinational corporations.

The case analyzed in this contribution represents a possible methods of cooperation between enterprises along the value chain, outsourcing a number of activities and processes that can no longer be advantageously managed internally and bringing about a number of different forms of cooperation among companies.

The shift from a mediation marketplace to a collaboration marketplace creates real strategic networks between cooperating companies, were relationship are mediated by the marketplace authority. It is only in the dynamic and emergent implementation of new services that the change in behavior lies. Companies participating to static mediation marketplaces or companies entering AgriOk after the transition would not experience this behavioral change.

Discussion

The case described above shows how a marketplace in responding to the requests of its members proposes increasingly advanced services and finally turns into a governing structure, an organizing platform, or a *bouncer* as the CEO of AgriOk said.

From the point of view of the marketplace, which we took in the case study, this emergent result is nothing short of a paradoxical situation. The very existence of a market place is traditionally connected to its ability to mobilize a market where the higher the number of players the higher the revenues. The implementation of new services lead instead the member companies to ask the marketplace to become an exclusive club with clear rights for entrance and acceptance.

In implementing rich business process outsourcing capabilities, the marketplace has in fact moved its service offering to support networks instead of markets. While originally they were able to support exchanges that are straightforward, nonrepetitive, and require no transaction specific investments – in other word a market, they found themselves involuntary architects of networks where companies are involved in an intricate latticework of collaborative ventures with other firms over extended periods of time. The disconnect with the past is that while normally these network relations are kept by a firm-to-firm partnership [3], with the new services they are mediate by a third party. The marketplace assumes a new – maybe unwanted, surely serendipitous – role that we term *strategic mediator*. The paradox in this role is the incongruence between market mediator – thriving on big numbers – and strategic mediator – thriving on scarce resources. In the paradox lies the possibility to create new collaborative forms and new business models. The transition for the marketplace is emergent and unclear as the rules governing this balancing act are still not known.

From the point of view of the member companies, the very concept of outsourcing should being reconsidered, no longer being a one-to-one relationship between two entities wishing to carry out, on a contractual basis, transactions that can no longer be conveniently governed through internal hierarchy. Outsourcing becomes a multilateral technology-mediated relationship, where technology becomes the real

counterpart of the outsourcing relationship. A good balance between organizational design and strategic use of ICT creates flexible boundaries in the company and at the same time optimizes transaction and production costs, searching for the optimal configuration.

Outsourcing, as it is meant in this paper, enables strategic choices that maintain the competitive advantages of the companies opting for such organizational solution. Therefore, the decision to outsource is not only attributable to the need of the management to contain costs. Outsourcing is the organizational solution that allows the companies implementing it to design operational structures and mechanisms that are more flexible, mobile and dynamic, closer to the end market and finally more competitive.

As a consequence, it is necessary to redefine the organizational boundaries of enterprises, where, in a continuum between market and hierarchy, the procurement outsourcing process, which is allowed by the very adoption of ICT, becomes a major factor in creating such new organizations, characterized by networks of enterprises. In reality, the outcome is an improper market or closed market, whose participants are the subjects having access to the technological platform, which in turn becomes more and more an organizational or organizing platform.

While the traditional concept of outsourcing consisted in the investigation of the various opportunities offered to companies when facing the choice between the mere making externally or internally, the current complexity of emerging organizational interdependencies, due to ICT giving easy access to a growing number of participants, calls for the adoption of new decisional criteria. The concept of market is being altered, where networks of increasingly more overlapped companies compete against and/or cooperate with each other. Therefore, the alternatives are: to make within the company boundaries, to buy within a closed market or to buy outside a closed market. The prevailing alternative here is to buy within the closed market, which represents the real strategic network, i.e., the subjects participating in the network enjoy competitive advantages that cannot be enjoyed by those who do not participate in it.

And what about the role of the marketplace? The traditional concept of outsourcing implied two contractual parties and therefore a bilateral relationship, whereas according to the new concept of outsourcing a relationship is being established between one subject and a network of companies connected through a single technological platform provided by the marketplace. This very single technological platform becomes the reference base of the improper, or closed, market. The access to this closed market is regulated by the manager of the technological interface. Is it fair, then, to define such improper or closed market as a technology-mediated market?

Based on the case studied in this contribution, it is actually possible to come to this conclusion and give an affirmative answer to the above question. However, these results are the first available and need to be further investigated through in-depth studies of multiple evolving marketplaces. The ideas of marketplace as a strategic mediator, the improper market, and their relation need to be extended and generalized. One thing is sure: the trend that many companies are following today in

the management of their organizational processes consists in turning to a growing number of new, hybrid, mobile, hard-to-manage methods for externalization of various company functions. The extent to which this will happen through imperfect markets created and maintained by strategic mediators is the question that needs an answer.

References

1. Ciborra, C. (1993) *Teams, Markets, and Systems: Business Innovation and Information Technology*. Cambridge University Press, Cambridge
2. Willcocks, L. and Lacity, M.C. (2001) *Global Information Technology Outsourcing in Search of Busines*s *Advantage*. Wiley, New York
3. Powell, W.W. (1990) Neither market nor hierarchy: Network forms of organization. *Research in Organizational Behavior*, 12, 295–336
4. Holzmuller, H. and Schlichter, J. (2002) Delphi study about the future of B2B marketplace in Germany. *Electronic Commerce Research and Application*, 1, 2–19
5. Bakos, J.Y. (1997) Reducing buyer search costs: Implications for electronic marketplaces. *Management Science* 43(12), 1676–1692
6. Philipps, C. and Meeker, M. (2000) The B2B internet report: Collaborative commerce. Morgan Stanley Dean Bitter Research, New York
7. Christiaanse, E. and Markus, L. (2003) Participation in collaboration electronic marketplaces. Paper presented at Hawaii International Conference on System Science, January 6–9, Hawaii, USA
8. Coase, R.H. (1937) The nature of the firm. *Economica*, 4(16), 476–477
9. Williamson, O.E. (1975) *Markets and Hierarchies. Analysis and Antitrust Implication*. The Free Press, New York, USA
10. Thorelli, H.B. (1986) Networks: Between market and hierarchies. *Strategic Management Journal*, 7, 37–51
11. Williamson, O.E. (1981) The economic of organization: The transaction cost approach. *American Journal of Sociology*, 87(3), 548–577
12. Van Maanen, J. (1979) The fact of fiction in organizational ethnography. *Administrative Science Quarterly*, 24, 539–550
13. Cheon, M.J., Grover, V., and Teng, J.T.C. (1995) Theoretical perspectives of the outsourcing of information systems. *Journal of Information Technology*, 10, 209–219

Externalization of a Banking Information Systems Function: Features and Critical Aspects

N. Casalino and G. Mazzone

Abstract The growth of financial services is today a reality and carries Italian banks in strong competition in the European market. Unique money introduction, European regulatory dimension and new trend of banking internationalization, which increase the number of subsidiaries in several countries, involve ICT challenges to compete not only in a national contest, but also in a European predominance theatre. The trend, that we analyze in this work, is represented by a strengthening of Information Systems function, with regard to enterprise organizational strategies, like a key-factor to enhance performance and to support new value creation by means of a Service Oriented Architecture paradigm. Starting by this context and considering the "cost management" plan, we analyze the IT services outsourcing strategy with a theoretical approach supported by the empirical case of one of the main banking groups. Besides, this work aims to systematize the current outsourcing process, trying to evaluate ICT impacts and change management aspects.

Introduction

Last 10 years were characterized by a strong qualitative and quantitative increase of ICT investments in banking sector, all planning in order to achieve progressive automation of new business areas and a quick introduction of innovative technologies. The trend we analyzed is represented by the increasing of Information Systems (IS) function role, with regard to enterprise strategies, like a key-factor to augment productivity and to support new value creation [1]. The growth of financial services sector border is today a reality and carries Italian banks in strong competition in the European market. Concerning technological priorities that banking system is facing, an IDC survey [2] emphasizes at five positions of ranking: (1) compliance and risk management; (2) security and struggle against frauds; (3) corporate efficiency increasing; (4) sourcing strategies; (5) IT infrastructure revision and

Università LUISS – Guido Carli, Roma, Italy, ncasalino@luiss.it, gmazzone@luiss.it

innovation. Considering this context, banks are checking own systems, with focus on ICT architectures, in order to comprehend the effective compliance with SOA (Service Oriented Architecture) paradigm, that is a key-factor to surpass architecture rigidity and to augment enterprise performance. In this contest, it is important to consider the "cost management" strategy, that banks are implementing and deciding to adopt for the next years.

Banca d'Italia data set already reflect costs trend with regard to ICT [2]. In 2005, Italian banks spent in ICT sector about 6.3 millions of euro (versus 6.2 in 2004, with an increase of 0.8%), and 31% is assigned to pay elaboration systems realized by banking group third party. This item augments his weight in 3 years period (2003–2005), from 26 to 29%, and to 31% at end of 2005. According to the interpretation of these empirical evidences, and from the case study we present in this work, some general observations can be made. First, the recent trend on bank's inclination to manage the total budget is changed. The empirical case of banking group underlines that banking system has recourse to a product-company (in this case ICT specialized), so-called "captive", internal at the banking group, oriented to supply services that before were requested and realized by external companies [1, 3]. So we can observe two main strategic orientations: costs cutting and M&A processes. So, we explain these strategies, in order to comprehend future implications. Second, in terms of strategy and efficiency definition, the paper will describe recent studies that debate about outsourcing strategy, in order to comprehend main benefits and advantages linked to this technique. In particular, we will describe the case of one of the main banking groups and the evolution of 5 years period (2002–2007). We will represent main strategic decisions to re-designing the organizational network, with support of sourcing [4, 5] and finally, we will analyze causes and reasons which have conducted to the choice, the organizational and technological impacts, critical items and benefits.

Integration Strategy and Cost Cutting

We have witnessed an unprecedented restructuring and consolidation trend in the financial services industry. Cross-border mergers are relatively frequent and on a domestic scale, mergers typically involve large universal banks and are often spectacular (e.g., the acquisition of Paribas by Banque National de Paris (BNP)). In particular, cross border M&A represents about 70% of cases. To confirm this theory, more recently, a somewhat higher level of activity has been observed, e.g.: ABN Amro – Antonveneta; Intesa – San Paolo; BNP Paribas – BNL; Unicredit – HVB, and recently with Capitalia (the process is on going). The coincidence of the consolidation trend in the financial sector with increased competition have led to believe that the massive banks reorganizations are a response to a more competitive environment. That is, as commercial banking becomes more competitive, banks need to examine all possible ways to eliminate inefficiencies from their cost structures, for example, by merging with other banks and realizing scale efficiencies through

elimination of redundant branches, back-office consolidation and outsourcing strategies, or by persevering with a strong cost cutting policy. It is important to observe that several factors, overall technological and regulatory frictions, affect the potential realization of scope and scale economies [6], linked to an outsourcing strategy. For example, a merger between two financial institutions may not readily lead to scale and scope economies because the integration of ICT structures may take time and high ICT investment.

At the end, implementation issues are crucial because it is a "core activity" of banking market. As the evidence shows, there are enormous differences between the "best practice" and "average practice" of financial institutions. Cultural differences between merged entities play an important role. Some empirical studies say that cost synergies in last Italian mergers are represented by 30% of cases. In this sense, the chance of an IS externalization or not is most likely of great importance.

Why an Outsourcing Strategy?

Starting by this context, we can develop the outsourcing strategy with a theoretical approach supported by an empirical case. IT outsourcing has two primary effects:

- First, it allows a desegregation of activities, breaking up the traditionally integrated value chain. One important manifestation of this, is that it facilitates a centralization of supporting activities (particularly, infrastructure and trading related activities, clearing, settlement and custody, different IT legacies coordination). This offers potential economies of scale in those disintegrated activities, which could also have implications for specialization within the value chain, and outsourcing in particular
- Second, it has profound implications for the cost strategies. More specifically, it facilitates a more efficient and effective planning of investments, realizing the outsourced structure that is the unique interface of banking group, to identify strategic needs, to design ICT network, to implement infrastructure, to test systems and realize ICT adjustment activities
- Organizational strategies can be summarized in these possibilities:
  - Assign all ICT activities to a third part or other instrumental company of bank holding – "outsourcing group" (several studies call this phenomenon "insourcing" because, in this case, company is internal)
  - Realize IT implementation and management of architecture in all group companies (duplicating functions and roles) – "not in outsourcing group"

A survey conducted by ABI-CIPA in 2006 [7] shows that ICT cost indicators have a decreasing trend about the outsourcing perspective, if we compare with not in outsourcing case with a gap of 1% in 2005. IS outsourcing decisions are characterized by their size, complexity, and potential reversibility. The benefits of outsourcing IS activities include reduced costs, due to the outsourcing vendor's economies of scale, immediate access to new technology and expertise, strategic flexibility, and

avoiding the risk of obsolescence [8]. The complexity of IS outsourcing is characterized by its intangible nature, multiple stakeholders with variable objectives [9], etc. These factors highlight the need to consider the value of such services over several (including post-contractual) stages to evaluate their success or feasibility. IS research has found that the determinants of successful outsourcing outcomes (such as quality processes and services) include the sharing of knowledge, having a detailed formal evaluation process, using shorter-term contracts, and outsourcing commodity IT on a selective basis [10, 11]. Other authors [12] identified several research articles that used a variety of methods to study IS outsourcing. IS studies have generally applied transaction cost economies to understand the outsourcing ratio, such as preclude obsolescence risk, access to new technology, and vendor economies of scale. Somebody [13] examined the relationships between several strategy-theoretic factors and the IS outsourcing decision. These factors include gaps in information quality, IS support quality, costs effectiveness, and strategic orientation. Applying "agency theory" to outsourcing, information asymmetry arises between the user and the supplier, because of supplier's expertise and inability of the user to effectively supervise and manage the project. Recently, studies have examined post-contract management as well as the middle and mature stages of the outsourcing lifecycle.

Several theories, [14, 15] addressed both trust and knowledge sharing issues.

The Case Study: Capitalia Banking Group

Capitalia S.p.A. is the Holding Company of the Capitalia Banking Group, born on July 1, 2001, from the synthesis of the former Banca di Roma (BdR), Banco di Sicilia (BdS) and Bipop-Carire (BC) banking groups. With the approval of the 2005–2007 business plan by the Capitalia Board of Directors on July 4, 2005, the corporate rationalization of the Capitalia Group continued. The goals of this reshaping included strengthening group governance, simplifying decision-making processes and pursuing additional cost and revenue synergies. In an ICT context, other objectives were IT-governance, SOA architecture, monitoring and supporting activities of strategic projects. We focused our analysis on decision of Capitalia about the IT services externalization from each commercial banks (BdR, BdS and BC) to a specific external company. In this context, Capitalia supports the outsourcing strategy, like a choice that generate value. In fact, in 2005 Capitalia Informatica (CI) was born. Why this choice?:

- To increase efficacy and efficiency of IS
- To reduce time to market of new products and services delivery
- To monitor performance, by the evaluation of a single company, i.e. Capitalia Informatica (with the advantage to have, in this case, an homogeneous comparison of economic indicators)
- To generate economies of scale, of scope and of experience

The perimeter impacted by this reorganization is synthesized in the Fig. 1.

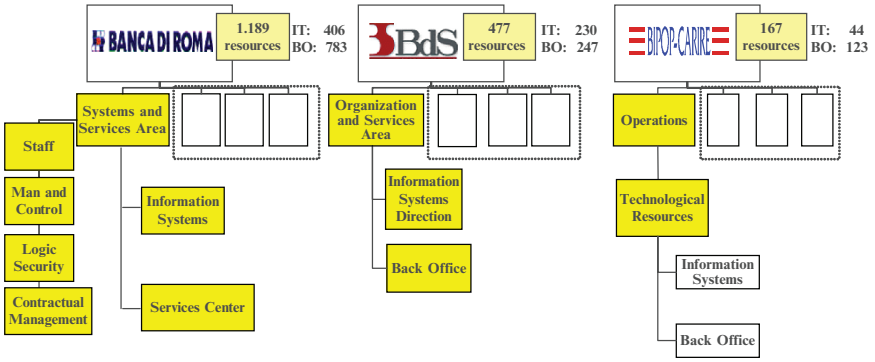


Fig. 1 Perimeter of reorganization

The outsourcing strategy is supported by about 1,800 people, which was allocated in IT, Back Office and Technology structures. In this sense, it is important to explicate how IT services were organized before and after outsourcing, how we tried to explain in the following Figs. 2 and 3:

When the rationalization will be completed (between BC and BdS) Capitalia Informatica will at first provide various services (commercial, financial and payment systems, innovative credit instruments and executive systems) through 439 human resources only placed in three locations (Rome, Palermo, Brescia). With regard to financial activities, traditional products and other services (Back Office) they will be provided by about 1,088 human resources placed on five locations (Rome, Potenza, Palermo, Brescia and Reggio Emilia). Finally, ICT services (telecommunications, office automation, disaster recovery, mainframe management) will be supplied by about 157 human resources placed on three locations (Brescia, Roma and Palermo).

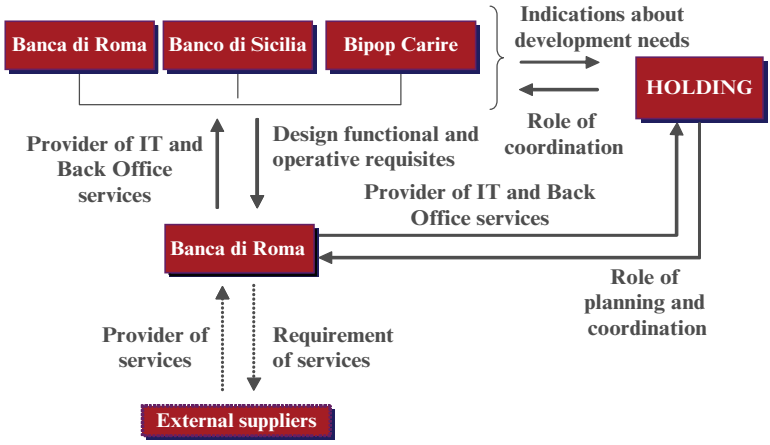


Fig. 2 IT Governance before outsourcing

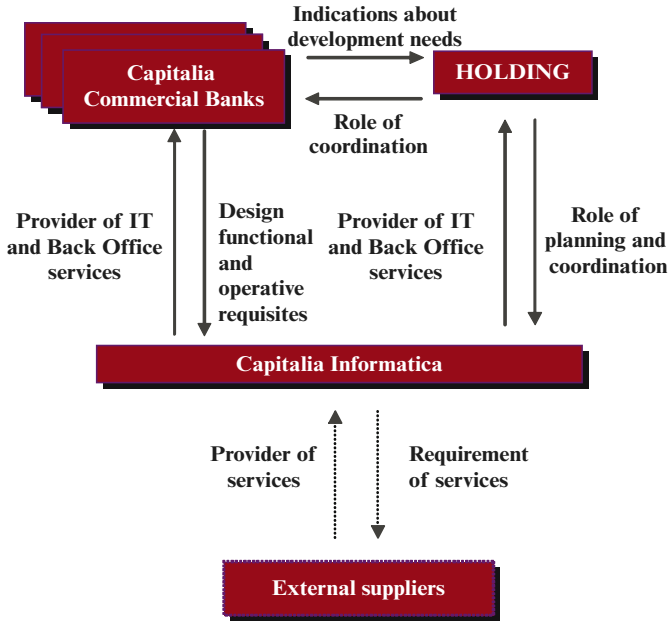


Fig. 3 IT Governance after outsourcing

By comparing two scenarios, we can observe that, before re-organization, BdR was the only provider of IT services for all banking group. For this reason, this bank met several problems in order to implement IT services because:

- BdR didn't know financial products and services offered by other two commercial banks (and so BdR had several criticisms to comprehend IT systems necessary to support these products and services)
- BdR had to manage different procedures, IT infrastructures (including own, BdS and BC systems), and several external providers of IT services
- Each bank had developed a strategic tacit and explicit knowledge [16, 17], that BdR didn't exploit, by an human resources point of view
- It was impossible to exploit economies of scale, of scope and of experience, and so realize a "cost cutting" strategy
- To conclude, all these points lead to two key-items:
  - Very high cost of IS planning, design, implementation, maintenance and evaluation of performance
  - Low exploitation with regard to economies of scale, of scope and of experience

After the outsourcing strategy and the following institution of Capitalia Informatica, all group were able to receive IT services and knowledge, that CI acquired by providing all services in a "learning by doing point of view". So all benefices found

confirmation with these economic indicators. In particular, the voices of cost, impacted by outsourcing strategy, were (2006 vs. 2005):

- IT costs, with a diminution of about 12%
- Cost of work, with a decrement of about 2%
- Revenues in augment of about 2%

The results show that strategy has properly worked, generating a new position of competitive advantage for all banking group.

Conclusions

Our work systematizes the current change process, trying to evaluate the impacts and the critical aspects. Data showed validate as the outsourcing chosen had founded precisely confirmation. In the current integration plan between Capitalia Group and Unicredit Group, as it also results from several market surveys, referring to aspects on which banks would give more emphasis regarding the "*day one*" (i.e. the day of full integration), we want to point out two main aspects: the ICT and the change management impacts. In the first case, the goals to pursue with more emphasis are:

- Define and develop target system to rapidly manage new products and services at the present not expected
- Develop a more advanced infrastructure for migration of datasets
- Support the implementation of regulation and operational tools for several bank branches (e.g. regulations, quick guides, set of forms, focused training)

Besides, to ensure the core business continuity, should be still solve some gaps about the following areas: payment systems, finance, products, customers and distribution channels. In the second case, the goal is to reduce the IS integration impact, in order to:

- Provide clients with differentiated information to easily operate with innovative financial products and services (e.g. remote banking, trading online, e-commerce, e-payment, tax payment, corporate banking)
- Manage the organizational impacts, coming from the group IS adoption, on the various bank structures
- Organize the logistic territorial perimeter accordingly to the new bank holding company configuration
- Contain the operational risks and minimize the impacts with training arrangements, support services and a better indoor communication

Last, but not least, this integration plan will require of several and specific training sessions, designed for people involved in process. People commitment is, in this case, a key-point for success of strategy.

References

1. Gandolfi, G. and Ruozi, R. (2005). Il ruolo dell'ICT nelle banche italiane: efficienza e creazione di valore, Bancaria Editrice
2. Rapporto ABI LAB 2007. (2007). Scenario E Trend Del Mereato Iet Per IL Settore Baneario. Presentazione Al Forum ABI LAB
3. De Marco, M. (2000). I Sistemi informativi aziendali, Franco Angeli, Milano
4. Williamson, O. (1975). Market and Hierarchies, The Free Press, New York
5. Coase, R.H. (1937). The nature of the firm, Economica, 4(16), 386–405
6. De Marco, M. (1986). I sistemi informativi: progettazione, valutazione e gestione di un sistema informativo, Franco Angeli, Milano
7. ABI-CIPA (2006). Rilevazione dello stato dell'automazione del sistema creditizio
8. Martinsons, M.G. (1993). Outsourcing information systems: A strategic partnership with risks, Long Range Planning, 3, 18–25
9. Malone, T. (1987). Modeling coordination in organizations and markets, Management Science, 33(10), 1317–1332
10. Grover, V., Cheon, M., and Teng, J. (1996). The effect of quality and partnership on the outsourcing of IS functions, Journal of Management Information Systems, 4, 89–116
11. Klepper, R. (1995). The management of partnering development in IS outsourcing, Journal of Information Technology, 4(10), 249–258
12. Lacity, M.C. and Willcocks L.P. (2000). Relationships in IT Outsourcing: A Stakeholder Perspective in Framing the Domains of IT Management Research: Glimpsing the Future Through the Past, R. Zmud (ed.), Pinnaflex, Cincinnati
13. Teng, J., Cheon, M., and Grover, V. (1995). Decisions to outsource information system functions: Testing a strategy-theoretic discrepancy model, Decision Sciences, 1, 75–103
14. Lander, M.C., Purvis, R.L., et al. (2004). Trust-building mechanisms in outsourced IS development projects, Information and Management, 4, 509–523
15. Lee, J.N. (2001). The impact of knowledge sharing, organizational capacity and partnership quality in IS outsourcing success, Information and Management, (38)5, 323–335
16. Nonaka, I. (1994). A dynamic theory of organizational knowledge creation, Organization Science, 5, 14–37
17. Polanyi, M. (1966). The Tacit Dimension, Doubleday, Garden City, NY

The Role of Managers and Professionals Within IT Related Change Processes. The Case of Healthcare Organizations

A. Francesconi

Abstract IT is often depicted as a force that will transform the production and delivery of healthcare services, promising lower costs and improvements in service quality. However, research on IT and organizational change emphasizes that the organizational consequences of new technology are not straightforward and easy to predict. In this paper we study why IT is framed as determining organizational consequences in the context of digital radiology implementation, showing that, contrary to the view of technological determinism as a case of repeated *bad practice*, the construction and enactment of technological determinism can be understood as an emergent strategy for coercive organizational change within a particular context of relationships between managers and professionals.

Introduction

Nowadays, the convergence between biomedical technologies and IT pervades hospitals, influencing changes in structures and IS, work practices and procedures, roles and responsibilities and even the professional identities. IT is often depicted as a force that will transform the production and delivery of healthcare services, promising lower costs and improvements in service quality. Recently, also Italian hospitals are facing with an increasing rate of IT projects both in the administrative area (i.e. ERP projects) and the clinical side. An area rich of potential applications of IT is digital medical imaging, due to the vast amount of data that have to be managed. However, diagnostic imaging devices alone can not deliver full value in service. Other technologies such as PACS (Table 1) (picture archive and communications system) must be considered too, as well as their integration with RIS (radiological information system), HIS (hospital information system) and EPR (electronic patient record) to better perform administrative tasks and distribution of reports [1]. PACS enables to manage, store, and distribute digital images from CT, MRI, X-ray, and

Università di Pavia, Pavia, Italy, afrancesconi@eco.unipv.it

Table 1 The contexts of PACS implementations

	Case A	Case B	Case C	Case D	Case E
N. of beds	$\approx 2,000$	$\approx 1,000$	≈ 600	≈ 150	$\approx 1,700$
N. of radiologists	11	15	23	5	12
Examination/year	$\approx 45,000$	$\approx 40,000$	$\approx 450,000$	$\approx 12,000$	$\approx 40,000$
Year of PACS acquisition	2001	2005	1997	2001	2004
Time for implementation	18 months	15 months	12 months	12 months	Not completed in all department

ultrasound imaging devices [2], within radiological departments (*small scale PACS*) or throughout the whole hospitals (*large scale PACS*) and outside. PACS components include image acquisition devices, systems for storage and retrieval of data, workstations for display and interpretation of images, networks to transmit information. There are many advantages in theory associated with PACS, such as more rapid diagnostic readings, a significant reduction in the number of lost images, more patients examined, fewer rejected images (and rescheduled exams), accelerated improvements in the productivity of radiologists and technologists, the elimination of films and the chemical products needed to develop them, and improved quality in patient care [3, 4]. Nevertheless, many departments have discovered that in spite of reduced film costs and improved image access for clinicians, they are not achieving dramatic overall performance improvements with PACS [5]. Therefore, we examine the change approach used by five Italian hospitals for PACS adoption to develop a richer understanding of IT related change processes, challenging some taken for granted assumptions.

Theoretical Background

The introduction of new technology in healthcare organizations is an occasion for organizational (re-)structuring [6] and research shows that technology related change results from a complex process of mutual influence between organization and a new technology [7–9]. With *fixed* technology such as CT scanners analyzed in Barley's study, physical modification of technology in use are not considered. Indeed, in the case of a complex and partially customizable technology such as PACS, forms and functions can vary by different users, different context, and in time. Nevertheless, in practice and in some popular management literature, IT is often depicted as an independent force that determines organizational consequences and outcomes [10]. Healthcare is a prime and well known example of such a technology-deterministic approach diffusion [11–14] also for IT [15]. When such a gap between research and prevalent practice remains, it is interesting to ask whether this is a case of permanent incorrect practice of change management or something else.

IT related change in many hospitals is complex, due to their organizational and situational characteristics, including the co-existence of administrative and

professional control structures, increasingly cost constraints, fast-evolving treatment methods and an institutional context characterised by the ferment of reforms [16–18]. Medical specialists emphasize their professional knowledge, skills and service orientations to justify professional autonomy, whereas managers try to coordinate and standardize medical activities and enhance professional output to increase organizational performance and reduce costs [19, 20]. A deep differentiation between physician and managerial roles persists [21, 22] often creating conflicts between orientations of managers and professional goals [23]. Moreover, medical professionals fight for gaining and maintaining their professional autonomy even with the control of *own* technology [24], sometimes leading to change resistance and inertia. In order to inquire how and why technological determinism is enacted, the concept of sense-making about technology [25, 26] can help to better understand this phenomenon. Orlikowski and Gash suggest that technology can be interpreted according to three different aspects: the nature of technology, the technology strategy and the technology in use. Consequently, managers and professionals build their own idea of technology, that is their technology frames [27]. We suggest that within hospitals there can be a discrepancy between these technology frames affecting the change process and contributing to the difficulties often faced with IT implementations.

Methods, Case Description and Discussion

We carried out a retrospective, multiple-case study of PACS implementation within five hospitals of Northern Italy. The raw data were collected through direct observations, interviews guided by a semi-structured questionnaire, and available documentation – such as cost-benefit analysis, PACS projects documentation, minutes of meeting and training course – during 6 months from 2006 to 2007. Two day for each case of direct observations of PACS use by radiologists and technologists were required, resulting in further informal interviews with them.

We have found two kind of IT related changes. Anticipated – and mainly top-down – changes are planned ahead by management coherently with their technology frame. They are often driven by economical performance objectives to reduce costs or increase volumes. They occur as intended toward the performance improvement, such as:

- The reduction in costs due to digital technology (film-less and no chemical products to develop images), even if some hospitals continue to use paper and film-based documentation too.
- The automation of image management, with a significant reduction in the number of lost images and in time for retrieving and archiving them, fewer rejected images and rescheduled exams.
- Sometimes, the reduction of administrative staff (i.e. archiving staff or secretaries previously employed to type medical reports) due to digitalization and automation.

Table 2 Main characteristics of PACS implemented

	Case A	Case B	Case C	Case D	Case E
PACS type	Large PACS	Small PACS	Large PACS	Small PACS	Large PACS
Integration with:					
RIS	Yes (partial)	Yes (full)	Yes (full)	Yes (partial)	Yes (full)
EPR	No	Yes	No EPR	No	No EPR
HIS	No	Yes (partial)	Yes	No	Yes
Other hospitals	No	No	No	Yes	No
Remote access	No	No	Yes	Yes	Yes
Film printing	On request	On request	Always	For external	Often
Speech recogn.	On other PC	Available	Available	Available	Not available
Medical reporting	Manual on PC + printing	Also manual + printing	Tape record + printing	Speech recognition + printing	Manual on PC + printing
Signature	Electronic	Autograph	Electronic	Autograph	Autograph

Emergent – and mainly bottom-up – changes arise from local use by physicians and technicians. These changes are mostly aimed at adapting PACS to contextual organizational procedures and to existing IT infrastructure and vice-versa being PACS customizable – as shown in Table 2 with different types, levels of integration, and functionalities adopted – facing the emergent IT troubles during implementation and the IT skill-gaps. They also arise as a *compromise* between the technology frames and the drivers of change of managers and professionals (Table 3). These kind of changes are not originally intended or fully deliberated ahead by management and affect the planned changes, such as:

- The over-exploitation by physicians of powerful functionalities of the new technology (i.e. more detailed imaging, new features to manipulate the images and to measure the objects within them, and so on) due to increased responsibilities – both ethical and legal and not only clinical – felt by radiologists; this often drives toward less rapid diagnostic readings and reporting and sometimes to the paradox of more difficulties (and time) in interpretations of images, now richer in details.
- The emergent troubles of integration with systems already existing that drives to limited improvements in the productivity of radiologists and technologists and in the whole lead time.
- The restructuring of work between physicians and technicians and the fears of the physicians in terms of role and power within the radiology department, with consequent inertia and change resistances.
- The augmented workload for radiologists, also when unplanned, due to emergent troubles with speech recognition – such as in case A where it is available only on another PC, requiring long instruction in spite of low performance, so discouraging its use, as well as in the case C due to its slowness, or case B where frequent crashes of RIS induce radiologists to abounding manual reporting – and electronic signature, etc.

Despite many advantages in theory associated with PACS, this study shows that managers and physicians tend to emphasize respectively economical efficiency and clinical efficacy as drivers and prime objectives of implementation of PACS, coherently with their technology frame and roles. This emphasizes the organizational differentiation as a structural and permanent issue within change process rather than a mere choice of correct change approach alone. As emerged during interviews and contrary to the view of technological determinism as a simplistic case of wrong practice within change process, the construction and enactment of technological determinism and an initial top-down framework for IT implementation is often considered crucial by management as a trigger to turn physician-input into a coherent steering force, limiting inertia to change and thus creating an initial basis for organizational transformation toward higher efficiency. A further evidence is the commitment of managers, particularly focused on this initial phase. As a matter of fact, the objective of efficiency is effectively pursued after the implementation, even if often only partially. However, the study confirms that IT related change is a series of many unpredictable changes that evolve from practical use of IT by professionals, due to

Table 3 Technology frames and change approaches

	Case A	Case B	Case E	Case C	Case D
PACS technology frame	M: tool for efficiency aligned with hospital cost containment strategy (in particular less archiving, film, chemicals and administrative costs) P: tool for diagnostic improvement but also with increased medical-legal responsibilities and workload			M: tool for increase volumes and DRG refunds P: tool for diagnostic and service improvement, interoperability and coordination	M&P: tool for service improvement, full tele-radiology, efficacy and research
Change approach	Top down	Top down	Top down	Top down	Mixed

M: Managers; *P*: Professionals

technical, organizational, behavioural, and also economical emergences, affecting what planned ahead by management.

Conclusions

This study suggests that healthcare organizations not only undergo processes of incremental alignment between IT and organization, but can have to face a *conflict* between technology frames and a *compromise* between managers and professionals aims, due to their deep organizational differentiation which affect the process of alignment as well as the performances. Like Orlikowski and Gash [26], we found that this incongruence can lead into difficulties and underperformance, but important is how the incongruence is *addressed* and *mediated* within hospitals. These considerations suggest that traditional change management tools and approaches alone can be insufficient to successfully face the IT related change within hospitals as mere spot IT projects. The permanent latent conflict and the structural role differentiation between managers and physicians are often deeper and wider than a IT project – limited in scope and time – can effectively face. Due to the ever changing medical technology and the rising role of IT, hospitals should start thinking consequently in terms of permanent processes/solutions to better *mediate* between their two souls, managerial and clinical, within continuous change processes, even if without attempting to fully pre-specify and control change. The results from these case studies, though they are to be deepened, suggest that empirical examples of deterministic approaches to technology implementation can be a strategy deliberately chosen by management to cope within a complex context of latent conflict and deep differentiation with medical roles. In so doing, it provides a richer and more credible explanation of the sustained prevalence of enacted technological determinism in spite of the well-established and well-known research that denounces this practice. Though this study does not refute such simplistic assumptions might exist, our results suggest that it is important to understand underlying organizational structures that affect changes.

References

1. Ratib, O., Swiernik, M., and McCoy, J.M. (2002). From PACS to integrated EMR. *Computerized Medical Imaging and Graphics* 27, 207–215
2. Huang, H.K. (2003). Some historical remarks on picture archiving and communication systems. *Computerized Medical Imaging and Graphics*. 27, 93–99
3. Bryan, S., Weatherburn, T.D.C., Watkins, J.R., and Buxon, M.J. (1999). The benefits of hospital-wide PACS: A survey of clinical users of radiology services. *British Journal of Radiology* 72, 469–472
4. Lundberg, N. and Tellioglu, H. (1999). *Impacts of PACS on the Work Practices in Radiology Departments*. New York: ACM Press

5. Hanseth, O. and Lundberg, N. (2001). Designing work oriented infrastructures. *Computer Supported Cooperative Work* 10(3–4), 347–372
6. Barley, S.R. (1986). Technology as an occasion for structuring: Evidence from observation of CT scanners and the social order of radiology departments. *Administrative Science Quarterly* 31, 78–108
7. Leonard-Barton, D. (1988). Implementation as mutual adaptation of technology and organization. *Research Policy* 17(5), 251–267
8. Markus, M.L. and Robey D. (1988). Information technology and organizational change: Causal structure in theory and research. *Management Science* 34(5), 583–598
9. Orlikowski, W.J. (1992). The duality of technology: Rethinking the concept of technology in organizations. *Organization Science* 3(3), 398–427
10. Robey, D., Boudreau, M.C. (1999). Accounting for the contradictory organizational consequences of information technology: theoretical directions and methodological implications. *Information Systems Research* 10(2), 167–185
11. Fuchs, V.R. (1968). *The Service Economy*. National Bureau of Economic Research and Columbia University Press (Eds.), Columbia: Columbia University
12. Drummond, M. (1987). Methods for economic appraisal of health technology. In Drummond M.S. (Ed.), *Economic Appraisal of Health Technology in European Community*. Oxford: Oxford University Press
13. Warren, K. and Mosteller, F. (1993). *Doing More Good than Harm: The Evaluation of Health Care Interventions*. New York: New York Academy of Sciences
14. Muir Gray, J.A. (1997). *Evidence-Based Health Care: How to Make Health Policy and Management Decisions*. London: Churchill Livingstone
15. Thompson, T.G. and Brailer, D.J. (2004). The Decade of Health Information Technology: Delivering Consumer-centric and Information-rich Health Care. Framework for Strategic Action. Bethesda, MD: Office of the Secretary, National Coordinator for Health Information Technology, US Department of Health and Human Services
16. Abbott, A. (1988). *The System of Professions – An Essay on the Division of Expert Labor*. Chicago: The University of Chicago Press
17. Scott, W.R., Reuf, M., Mendel, P.J., and Caronna, C.A. (2000). *Institutional Change and Healthcare Organizations*. Chicago: The University of Chicago Press
18. Kitchener, M. (2002). Mobilizing the logic of managerialism in professional fields: The case of academic health centre mergers. *Organization Studies* 23(3), 391–420
19. Mintzberg, H. (1983). *Structure in Fives. Designing Effective Organizations*. Englewood-Cliffs: Prentice Hall
20. Kinding, D.A. and Konver A.R. (1992). *The Role of Physician Executive*. Ann Arbor, Mitchigan: Health Administration Press
21. Kurtz, M.E. (1992). The dual role dilemma. In Kinding, D.A. and Konver A.R. (Eds.), *The Role of Physician Executive*. Ann Arbor, Mitchigan: Health Administration Press
22. Cicchetti, A. (2004). *La progettazione organizzativa. Principi, strumenti e applicazioni nelle organizzazioni sanitarie*. Milano: FrancoAngeli
23. Freidson, E. (1970). *Profession of Medicine*. New York: Dodd Mead
24. Smith, D.B. and Kaluzny, A.D. (1975). *The White Labyrinth: Understanding the Organization of Health Care*. Berkeley: McCulhan
25. Weick, K.E. (1990). Technology as Equivoque. In Goodman, P.S. and Sproull L.S., et al. (eds.), *Technology and organizations*. San Fransisco, CA: Jossey-Bass
26. Orlikowski, W.J. and Gash D.C. (1994). Technological frames: Making sense of information technology in organizations. *ACM Transactions on Information Systems* 12(2), 174–207
27. Griffith, T.L. (1999). Technology features as triggers for sensemaking. *Academy of Management Review* 24 (3), 472–488

ICT and Changing Working Relationships: Rational or Normative Fashion?

B. Imperatori[1] **and M. De Marco**[2]

Abstract This work explores the consequences of the managerial discourses on flexible work mediated by technology. The study – based on a multiple case analysis – points out the relevance and the impact of information and communication technology (ICT) on both "rational" firm's productivity and "normative" employees' psychological contract. Finally, we suggest some implementation guidelines for successful ICT work solutions.

ICT Solutions: "Unusual Liaisons" Between Employee and Organization?

Spin-offs, acquisitions, mergers, downsizing, "rightsizing", reductions in the workforce are solutions that often enhance the flexibility of an organization. However, all these changes have deeply influenced employee–organization contracts, not only in a formal sense, but – even more significantly – in a cultural sense [1]. The "single firm long-life work" has been substituted by "boundary-less careers"; the workers – not only the organizations – have become more flexible, more mobile across different firms and build and choose their own career paths [2].

In this revitalised labour market, modern firms face an apparent mismatch in retaining their competitive advantage. This is because they have to both invest in their (mobile) human resources to continually generate new knowledge and skills and look for organizational solutions capable of addressing changes that are unpredictable [3–6].

These reasons have sparked an ongoing debate on how to sustain working relationships in changing organizations. Great emphasis is placed on analysing the influence of the different formal contracts, human resource practices or management styles in shaping the nature of the relationship, but little attention has been

[1]Università Cattolica del Sacro Cuore, Milano, Italy, barbara.imperatori@unicatt.it
[2]Università Cattolica del Sacro Cuore, Dipartimento di Scienze dell'Economia e della Gestione Aziendale, Milano, Italy, marco.demarco@unicatt.it

paid to understanding the relevance of information and communication technology (ICT) as a practical organizational solution and its influence on defining employee perceptions and behaviours.

In recent years, the academic and managerial literature (the "discourse") on the employee–organization relationship mediated by technology has been developed, even in consideration of the technology impact on work flexibility [7].

From this theoretical perspective, the issue of "technology and work flexibility" is widely cited in the managerial discourse, although it seems to have non-homogeneous applications in business practices. Are "mobile work", "distance work", and "work mediated by technology" simply managerial fashions or real practices? What is their real impact on working relationships?

We believe that the new technological opportunities can be seen as a bridge connecting two different scenarios: from the organizational perspective, ICT solutions could be a way to support flexibility, knowledge-sharing, and development, while from employees' perspective, ICT solutions could be seen as a new approach to enhance their ways of working in the organization.

ICT Solutions as a Managerial Fashion

Managerial fashions are the result of institutional pressures that lead to a convergence in the structural features of an organization through a process of isomorphism, which helps to legitimise the actual organizational methods, thereby increasing the organization's likelihood of survival [8, 9].

ICT working solutions are undoubtedly a managerial fashion; the issue of "technology and work flexibility" is widely cited in the managerial discourse.

Management fashion-setters – consulting firms, management gurus, mass-media business publications and business schools – propagate management fashions, by which we mean "transitory collective beliefs that certain management techniques are at the forefront of management progress" [10–12].

Considering the nature of the ICT fashion, management scholars have recognized two contradictory types of employee-management rhetoric [13–15]. Barley and Kunda, adopting the terms "rational" and "normative" to distinguish between the two [11].

The key assumption underlying the *rational rhetoric* is that work processes can be formalized and rationalized to optimize productivity. Therefore, management's role is to engineer or reengineer organizational systems to maximize production processes and to reward employees for adhering to such processes.

The key assumption underlying the *normative rhetoric* is that employers can boost employee productivity by shaping their thoughts and capitalizing on their emotions. The role of managers is to meet the needs of employees and channel their unleashed motivational energy through a clear vision and strong culture. Therefore, the normative rhetoric prescribes methods of hiring and promoting those employees who possess the most suitable cognitive and psychological profiles, as well as techniques that satisfy the psychological needs of employees through benefits, enriched

tasks and empowered management styles. These offer ways to survey and shape employee thoughts and loyalties with visionary leadership and organizational cultures in order to channel the motivational energy and creativity that these techniques release.

Applying this "fashion perspective" to the technology and work flexibility issue, the following two key questions arise, which we want to test through our research project.

- Does management adopt technical work solutions in a 'rational' way to enhance productivity?
- Does management adopt technical work solutions in a 'normative' way (i.e. socio-affective adoption) to shape the employees' emotions?

ICT Solutions as "Rational" way of Organizing Work

The advent of ICT is changing the traditional ways of working as well as affecting the individual's spatial relations within the company. In particular, the new technologies are the harbinger of what is known as the "wired organisation" [16, 17], where a large part of the work relations are mediated by technology.

The changes underway in the ICT sphere enable the progressive abandonment of the old work logics because sharing space is no longer a constraint to which to subject many types of employees. Indeed, not only does the organisation transfer certain types of knowledge through electronic channels to the workforce, but also the people working inside and outside the company exchange information and knowledge electronically.

Potentially, these factors translate into a gradual leaving behind of the traditional concept of work space, forming the basis of the "distance worker" rhetoric, according to which technology is a mediator of the relation between the employee and the company and enables the work to be moved from inside to outside the organisation; this can foster different positive outcomes for the organization, such as the possibility to relocate production and business units, trim labour costs, enhance organizational and workforce flexibility, coordinate geographically remote operations, and improve the use of organizational space and working time.

Nevertheless, several companies that have chosen or offered this method of distance work have retraced their steps and "e-working", cited in the managerial discourse as a flexible and innovative solution, is finding it hard to get off the ground.

- Is ICT-working a true "rational" solution/fashion?

ICT Solutions as a "Normative" way to Organize Work

Rousseau and McLean Parks describe the employee–organization exchanges as promissory contracts, where commitment of future behaviour is offered in exchange

for payment [18]. According to this definition, employees develop some expectations about the organisation's context and adapt their behaviours according to their perception of the reciprocal obligation [19, 20].

Research on labour contracts suggest that they are idiosyncratically perceived and understood by individuals [17, 21]. Subjectivity can lead to disagreements between the parties on terms and their meanings, especially in transforming organizations, where the reciprocal obligation can vary in time. The subjective interpretation of the labour contract has been called "psychological contract". Originally employed by Argiris [22] and Levinson [20] to underscore the subjective nature of the employment relationship, the present use of the term centres on the individual's belief in and interpretation of a promissory contract. Research has confirmed that employees look for reciprocity in a labour relationship and that their motivation to work is heavily influenced by their perceptions: the more the relationship is perceived as balanced, the more employees are disposed to contribute and perform, even beyond the duties called for by their role [23–25].

ICT enables work solutions that move the work from inside to outside the organisation and can have different positive outcomes on the employees' perception of the organization's determination to meet their needs. In a word, ICT solutions could have a positive impact in shaping psychological contracts as a form of signalling.

- Is ICT-working an emotional "normative" solution/fashion?

ICT Solutions in IBM and in I.Net: Research Design

To test the nature of ICT solutions as managerial fashion (i.e. rational vs. normative), we adopted a qualitative research strategy based on a multiple case analysis [26]. The two emblematic cases examined are the European Mobility Project at IBM and the Tele-working Systems at I.Net. Both projects had the goal of enhancing workforce mobility through technology.

The relevance and the significance of these projects to our research is confirmed by the fact that both of them: (a) centre on advanced technology solutions; (b) use metrics to measure project success; (c) adopt the longitudinal perspective (from needs analysis to implementation and evaluation phase); and (d) produce different outcomes.

While IBM and I.Net are two different kinds of companies, they each share several key features that make them good comparables for our research aims: both are focused on internal technological innovation (i.e. both employ technology-oriented people, highly familiar with new solutions) and external technological innovation (i.e. both supply clients with technology solutions). We analyzed the application of ICT work solutions taking into account the relative managerial processes. Our research mainly focuses on the organizational viewpoint, but we also identify some organizational constraints and facilitators.

In November 1999, IBM launched its Europe-wide Employee Mobility Project, an international and inter-functional project the goal of which is to develop and

increase the work mobility initiatives offered by IBM, pinpointing and implementing technical and organisational solutions for mobile workers and providing the tools needed to support them. The project is still underway and has already produced numerous effects. The project was promoted internally by two of IBM's vice-presidents and involved not only the identification and assignation of specific responsibilities, but also the definition of organisational roles (Mobility Leader) and coordinating bodies (Regional Mobility Steering Committee and Mobility Project Team).

In October 2000, I.Net launched its Tele-working System, an inter-functional project to help some internal employees accommodate specific individual work and life balance needs. The project was coordinated by the Human Resource Dept. and involved different line managers. However, the project has now been closed and none of I.Net's employees are currently involved in the scheme.

ICT Solutions as Rational or Normative Fashions? Research Results

IBM's experience attests to the feasibility and usefulness of the new work methods and solutions in enhancing the flexibility of the work space.

The project has enabled the *company* to improve its economic health – thanks to the development of a corporate image in line with the e-business era, improve infrastructure management, and increase work productivity, above all, thanks to the quantifiable and easily monetised cost-savings in the management of its real estate. In particular, much prominence is given internally to the higher results achieved in real estate management, which are directly attributable to the project and which have freed up financial resources. The number of people sharing a desk at IBM has increased and currently the average number of employees per shared desk is 2.6. In addition, the density of the workforce has increased from 180 to 170 sq m per person.

Another result in Italy is the imminent quitting of two office buildings in the Milan and Rome areas, which will enable the company to more flexibly manage its work spaces. In Spain, branch office premises will be closed in the Madrid area and an increase in the use of shared desks is envisaged, which will lead to further cost-savings. Finally, the launch of new e-place projects are planned for some IBM offices in the Southern Region (Istanbul, Lisbon, Tel Aviv).

The percentage of employees who use this work method has increased, despite the reduction in the overall number of staff employed by IBM group. Project-related results cited include a general improvement and strengthening in staff satisfaction; a more balanced management by employees of their family and working life; and greater flexibility and autonomy in the time management of clients (on a par with the hours worked). The employee's decision to join the project is usually voluntary and is discussed with their manager. More and more people in IBM interpret this new method of working as an opportunity.

On the other hand, the I.Net project had a very different organizational impact. Although it has since been wound up, it was a successful initiative that fostered no internal resistance, either from the employees or the line managers, and the project was closed purely due to the changing needs of the employees themselves.

The stated goal of the organization was to signal its employee focus, which it did successfully. However no other, more productive goals were perceived by the company. Currently, no employees are enrolled in the programme and this has led to the winding up of the project until such time the company receives a new request from an employee.

The project, thanks to I.Net's internal climate and its employer branding in the job market, enabled the company to improve its capacity to meet the work and life needs of its employees and reduce absenteeism. But, more importantly from the company's standpoint, the project has given the employees an emotional signal that makes them feel organizationally more embedded.

Both these cases highlight the existence of common critical issues related to the social and interpersonal dimension of their work, including potential negative factors, such as a diminished sense of belonging to the work group; loss of identification; loss of social relations with colleagues; and resistance related to loss of status, all tied to the symbols of space. Some difficulties also emerged in terms of the inadequacy of the tools and/or human resource management logics, with people remaining anchored to the "traditional" places of work. Situations have arisen where the employee has complained of a feeling of being poorly valued by their boss, while these latter have reported a fear of losing control over their own staff.

Lastly, practical hurdles have been reported related to the need to have an "alternative work space", one that adequately meets needs, which is not always available at the employee's home, and to have access to the use of efficacious technological supports.

These preliminary results lead us to express the following considerations.

Firstly, both case studies confirm a substantial coherence between the managerial discourse and the effective situation analysed, even though the scenario investigated seems privileged from this viewpoint and that even the actors describe it as unusual. This corroborates the theory of Abrahamson and Fairchild on the temporal divergence, in some cases, between managerial discourse and practice, but, on the other hand, also helps us to better understand the dynamics that can favour or hinder the convergence of practices with managerial discourse.

Secondly, IBM adopted the ICT solutions in a rational way, with measurable outputs on firm productivity. On the other hand, the adoption and implementation of ICT solutions by I.Net was more normative, with a relevant impact on the psychological perceptions of the employees of the reciprocity of the contractual obligations.

All of which enables us to confirm the possible dual nature of ICT-working solutions and their positive impact on the employees' psychological contract, even when the adoption is solely nominal.

Generally, however, this work method does not seem at all widespread, so it is certainly appropriate to speak of a managerial fashion that still seems to lack a consolidated following. Nevertheless, the implementation of these managerial practices in the two cases in question can help us identify some useful guidelines.

ICT Solutions: How to Implement the Managerial Discourse

The literature on managerial fashions cites the gap that sometimes distances theory from practice as one of the reasons hindering the diffusion of these practices [2]. This paragraph has the objective of trying to partly bridge that gap. Our analysis indicates clearly the importance of a logical development that envisages three different steps.

Step 1: Bilateral Needs Analysis and Goal-Setting

The redesign of the work times and spaces assumes the upstream production of a feasibility study that not only analyses the needs of both company and employees, but defines concrete and realistic objectives. These bases will enable the company to introduce new forms of flexible working that are capable of marrying and reconciling the diverse needs of the company with those of the individuals, without running the risk of designing projects that lack coherence and which are de-contextualised from the real needs of the interested parties.

Step 2: Introduction of an ICT-Working Solution

The managerial techniques used for dealing with the flexibility of the work space require the evaluation and overcoming of constraints (within and without the company) and the development of some organisational preconditions capable of maximising adoption and acceptance. In many cases, technology is a facilitator, but there are other kinds of hurdles to surmount, ones that are:

- Structural (i.e. flexibility is not suitable for everyone: the corporate population needs to be segmented in line with the feasibility and the practicability of the various and possibly graded solutions)
- Regulatory (i.e. Italian labour legislation has long impeded the approval of provisions aimed at introducing flexibility to the space-time aspect of the work performance, because it has not yet been updated to cover the new working possibilities offered by technology)
- Cultural (i.e. the idea of "always being present" is still widespread, by which "presence = productivity"; this logic is clearly antithetic to that of "working outside the company")

- Psychological (i.e. the natural psychological resistance to change of the employees themselves, deriving from the fact that any change in working methods necessarily and inevitably has an impact on the daily routines of the individuals due to the fears and anxieties triggered by these changes)

Step 3: Monitoring and Measuring Results

The last step calls for both the continuous monitoring and the final measuring of the results achieved for the company and for the employees. Continuous monitoring is a fundamental factor in enabling the correction of any errors and to identify any required changes; while the accurate measuring of the results achieved (better if concrete, tangible, quantitative) is of significant importance because it enables the objective assessment of the outcome of the project implemented and, above all, can support future projects of a similar nature as well as the decision-making process.

Conclusion

The employment market currently is the object of a far-reaching cultural revolution that is affecting the work relationship. Values and principles, such as loyalty to the company and a job for life are gradually giving way to concepts such as employability, professionalisation and entrepreneurship.

The companies explain (and justify) this trend as instrumental to the flexibility and cost-reductions demanded by an increasingly competitive and global scenario. However, one might assume that all this would lead also to a change in the context and in the forms of social interaction between the individuals in the company and between the company and the employee. Indeed, in this sense, companies are moving towards organisational forms that increasingly force them to make a trade-off between greater flexibility and the diminishing of the organisational commitment of the people who work for them.

The two projects discussed attest to the business opportunities sparked by the new technological solutions in supporting work flexibility, but, more generally, in supporting the emotional relationship (i.e. the psychological contract) between the employee and the organization. This “unusual liaison” – i.e. the ICT solution – is particularly relevant when it comes to the actual nature of the working relationship.

Firstly, it appears to confirm the alignment of the managerial discourse with organizational practices. Our results are aligned with the “time-lag” theorized by Abrahamson and Fairchild [27], which characterises managerial discourse and practice.

Secondly, the substantial adoption of technology based work systems proves that both rational and normative adoption are possible.

Finally, the two cases enable us to identify several critical issues and guidelines for the design and implementation of technology based work systems – to sustain the contamination of practices – such as: the dual approach (the organizational and the employer viewpoint) during the needs-analysis and goal-setting phases; the relevance of a coherent organizational culture and human resource system (i.e., especially appraisal and reward systems); the removal of organizational structural constraints; the management of cognitive resistances; and the importance of the evaluation and monitoring phases during the project processes.

References

1. McLean, Parks J., Kidder, D.L. (1994). "Till Death Us Do Part…" Changing work relationships in the 1990s. In C.L. Cooper and D.M. Rousseau (Eds.), *Trends in Organisational Behaviour*, vol. 1. New York, NY: Wiley
2. Arthur, M.B., Hall, D.T., and Lawrence, B.S. (1989). (Eds.). *Handbook of Career Theory*. New York, NY: Cambridge University Press
3. Levitt, T. (1960). Marketing myopia. *Harvard Business Review*, July–August
4. Prahalad, C.K. and Hamel, G. (1990). The core competence of the corporation. *Harvard Business Review*, 68, 79–91
5. Sambamurthy V., Bharadwaj, A., and Grover, A. (2003). Shaping agility though digital option. *MIS Quarterly*, 27(2), 237–263
6. Wernerfelt, B. (1984). A resource-based view of the firm. *Strategic Management Journal*, 5, 171–180
7. Robinson, S.L., Kraatz, M.S., and Rousseau, D.M. (1994). Changing obligations and the psychological contract: A longitudinal study. *Academy of Management Journal*, 37(1), 137–152
8. Abrahamson, E. (1996). Management fashion. *Academy of Management Review*, 16, 254–285
9. Powell, W., DiMaggio, and P.J. (Eds.) (1991). *The New Institutionalism in Organizational Analysis*. Chicago, London: University of Chicago Press
10. Abrahamson, E. (1997). The emergence and prevalence of employee-management rhetorics: The effect of long waves, labour unions and turnover. *Academy of Management Journal*, 40, 491–533
11. Barley, S. and Kunda, G. (1992). Design and devotion: surges of rational and normative ideologies of control in managerial discourse. *Administrative Science Quarterly*. 37, 363–399
12. Guillèn, M.F. (1994). *Models of Management: Work, Authority, and Organization in a Comparative Perspective*. Chicago: University of Chicago Press
13. McGregor, D. (1960). *The Human Side of Enterprise*. New York: McGraw-Hill
14. Scott, W.R. and Meyer, J.W. (1994). *Institutional Environments and Organizations: Structural Complexity and Individualism*. London: Sage
15. McKinlay, A. (2002). The limits of knowledge management. *New Technology, Work and Employment*, 17(2), 13, 76–88
16. Stover, M. (1999). *Leading the Wired Organization*. NY: Neal Schuman
17. Rousseau, D.M. (1989). Psychological and implied contracts in organisations. *Employee Responsibilities and Rights Journal*, 2, 121–139
18. Rousseau, D.M. and Mclean Parks, J. (1993). The contract of Individuals and organisations. In B.M. Staw and L.L. Cummings (eds.), *Research in Organisational Behaviour*, 15, 1–43. Greenwich, CT: JAI Press
19. Gouldner, A.W. (1960). The norm of reciprocity: A preliminary statement. *American Sociology Review*, 25 (2), 161–178

20. Levinson, H. (1962). *Men, Management and Mental Health*. Cambridge, MA: Harvard University Press
21. Schein, E. (1980). *Organisational Psychology*. Englewood Cliffs, NJ: Prentice-Hall
22. Argiris, C.P. (1960). *Understanding Organisational Behaviour*. Homewood, IL: Dorsey Press
23. Adams, J.L. and Rosenbaum, W.B. (1962). The relationship of worker productivity to cognitive dissonance about wage and equity. *Journal of Applied Psychology*, 46, 645–672
24. Organ, D.W. (1997). Organisational citizenship behaviour: its construct clean-up time. *Human Performance*, 10, 85–97
25. Van Dyne, L., Cummings, L.L., and Mclean Parks, J. (1995). Extra-role behaviours: In pursuit of construct and definitional clarity. In B.M. Staw and L.L. Cummings (eds.), *Research in Organisational Behaviour*, 15, 44. Greenwich, CT: JAI Press
26. Yin, R.K. (1993). *Case Study Research: Design and Method*. London: Sage Publication
27. Abrahamson, E. and Fairchild, G. (1999). Management fashion. lifecycles, triggers, and collective learning processes. *Administrative Science Quarterly*, 44, 708–740

Temporal Impacts of Information Technology in Organizations: A Literature Review

D. Isari

Abstract In the literature about information technology and organizational change, organizational dimensions like distribution of authority and control, standardization, centralization, specialization of labour have received great attention but much less attention has been given to the study of the relationship between information technology and the temporal dimension of the organization of work, in spite of the fact that during the last decades there has been an increasing interest in time in the organizational literature. The research on the temporal implications of information technology in organizations, though still limited, has started to gain a stable attention during the last decade. The aim of the paper is to propose a literature review of this studies, in order to examine what concepts of time and theoretical frameworks have been used to analyze the temporal dimension; what typologies of IT have been taken in consideration as relevant from a temporal point of view, what epistemological, theoretical and methodological perspectives have been adopted in empirical studies on the topic so far. Considerations on the state of the art and future directions for research on this topic conclude the paper.

Introduction

It is generally accepted that information technology, when implemented in organizations, speeds up business processes at an enormous rate and thereby saves the adopting organizations a great amount of time. In spite of its significance in temporality, research on temporal impacts of information technology in organizations is still limited [1].

In the literature about information technology and organizational change, organizational dimensions like distribution of authority and control, standardization, centralization, specialization of labour, organizational size have received great attention but much less attention has been given to the study of the relationship between

Università Cattolica del Sacro Cuore, Milano, Italy, daniela.isari@unicatt.it

information technology and the temporal dimension of the organization of work, in spite of the fact that we can consider the time dimension as one of the fundamental variables in organizational analysis since the early scientific management movement [2], and that during the last two decades there has been a growing interest in time as a variable in organizational analysis and an increase of attention on this topic in the organizational literature [3–6].

The research on the temporal implications of information technology in organizations, though still limited, has started to gain a stable attention during the last decade (interest which has lead in 2002 to the publication of a special issue on Time and IT in *The Information Society*).

In order to present a synthesis and a critical analysis of the literature examined, the paper is designed in order to addresses the three following questions:

- What are the concepts of time and the theoretical frameworks used to analyze the temporal dimension, and are there any prevalent ones?
- In empirical studies, what typologies of IT have been taken in consideration as relevant from a temporal point of view?
- In empirical studies, what epistemological, theoretical, methodological perspectives have been adopted, and are there any prevalent ones?

The analysis driven by these questions will guide our considerations on the state of the art and the future directions for research on this topic.

Concepts of Time and Theoretical Frameworks

Anthropological literature [7, 8] sociological [4, 9–11] and organizational literature [3, 5, 10, 12] have contributed to conceptualize time as a social and cultural construction, opening the way to a view of time as plural, multifaceted, relative, culturally determined, embedded in contexts and practices.

As far as organization theory is concerned, there has been a shift from a view of time as objective, external, universal (i.e. in Taylor) to the consideration of the internal, particular time of the individual organization: the cultural perspective on organization has acknowledged time as a fundamental dimension of organizational culture [12, 13], and in the last two decades conceptualizations of 'Organizational time' have driven attention to the co-existence of a plurality of internal and particular times and temporal patterns within each organization [6, 14–16].

As we shall see, the papers examined for this review show that studies on the temporal implications of information technology in organizations have fully acknowledged the perspective of time as a social and cultural construction and that the conceptualizations of time and theoretical frameworks used for empirical research derive from anthropological and sociological studies, and from studies on organizational culture.

The classical study by Barley [16] on the effects of the introduction of CT scanners in the temporal organization of radiological departments introduces indeed a framework based on concepts derived from anthropological studies: the author

adopts the concept of "temporal order" and a set of temporal dimensions derived from the studies by Zerubavel [8] and acknowledges his distinction between temporal symmetry and temporal asymmetry among organizational actors as well as the distinction between monochronic and polychronic temporal frames derived from the work of the anthropologist Hall [7].

In his theoretical contribution on the time–space perspective in IT implementation, Sahay [17] points out the contribution that can be given by sociological perspectives taking explicitly into account the fundamental dimensions of time and space, and, in order to foster the integration of time–space analysis into IS research, proposes a framework based on the concept of social *spatial-temporal practice*, drawn from the notion and description of spatial practices in the work of the sociologist Harvey.

Sahay [18] proposes as well a framework based on national cultural assumptions about time in his work which examines the implications of national differences in the implementation of a GIS system.

Time is conceptualized as a dimension of organizational culture by Lee and Liebenau [19] who, in their study on the temporal effects of an EDI System on business processes, employ a set of temporal variables derived from the work on organizational culture by Schriber and Gutek [20]. In a previous article on the same case study, Lee [21] also included in his framework the notions of mono-polychronicity and temporal symmetry/asymmetry (see above).

Scott and Wagner [22] in their study on the implementation of an ERP system in a University adopt a sociological perspective, and, based on Actor Network Theory, consider time as multiple, subjective and negotiated among organizational actors.

A sociological perspective is also adopted by Orlikowski and Yates [6] in their study on the temporal organization of virtual teams, where, drawing from Gidden's structuration theory, the authors propose the notion of *temporal structures* pointing out that such structures are enacted through the daily practices of the team in a technology mediated environment and reproduced through routines.

Other papers studying virtual teams dynamics have explored time issues related to communication in computer mediated environments: time is conceived in terms of *social norm* in a contribution on temporal coordination and conflict management by Montoya et al. [23, 24]. The authors argue that the use of asynchronous, lean communication media interfere with the process of emergence of social norms about temporal coordination and, following McGrath's suggestion, that such environments may require deliberate creation of social norms, they test the effect of deliberate introduction of a temporal scheme on conflict management behaviour.

A recent work on virtual teams by Sarker and Sahay [25] recalls the dialectic between the opposite concepts of clock time and subjective time (where the notion of subjective includes both cultural and individual differences) analyzing the mismatches and opposing interpretations of time which arise from distributed work in countries with different time zones.

In two recent studies on mobile technology, concepts derived from the work of anthropologists are reproposed: Sørensen and Pica [26], analyzing police officer's rhythms of interaction with different mobile technologies, use Hall's distinction between mono and polychronic patterns of activity, and finally, the concept of

temporal order and the analytical framework proposed by Zerubavel [8] are adopted by Prasopoulou et al. [27] in their study on how the use of mobile phone by managers influence the temporal boundaries of work-nonwork activities.

Epistemological Perspectives and Methodologies Adopted

The literature examined, which includes 15 papers (1 theoretical and 14 empirical papers) covering in particular the last decade, has fully acknowledged, as pointed out before, the conceptualization of time as social construct, adopting theoretical frameworks derived from anthropological and sociological studies and organizational culture research.

As far as epistemological perspectives are concerned, in the group of empirical papers examined there is so far a prevalence of constructivist and interpretivist perspectives (9 papers out of 14) compared to positivist approaches, which is not in line with the overall tendency in IS research.

From a methodological point of view, the studies examined privilege qualitative methods: the majority of papers present case studies and longitudinal case studies (nine papers), showing a prevalence of ethnographic techniques for data gathering (observation, participant observation, open ended and semistructured interviews).

Two papers present the results of descriptive surveys based on questionnaires, and two papers present results from a field experiment where data were gathered from the communication transactions registered by the system.

It is interesting to point out that, as far as the research design is concerned, whatever the theoretical framework chosen, most papers examined do investigate the effects of IT on the temporal dimension in organizations (whether referred to business processes, worker's attitudes, communication and coordination processes, group dynamics, technology use) but very few papers have the explicit objective to explore the reverse direction of the relationship.

That is to say, still limited attention is paid to explore if and how assumptions on time and temporal orders (structures/cultures) existing in organizations affect the processes of implementation, use, interpretation of information technology.

Typologies of IT Examined in Empirical Studies

Though very limited, empirical research on temporal implications of information technology in organizations has in the last two decades covered a wide range of different systems and technologies.

A classification proposed by Failla and Bagnara [28] described different implications of IT on temporality distinguishing three classes based on the stage of evolution of IT (automation; decision support, virtual reality technologies).

With the exception of the pioneering study by Barley on the introduction of CT scanners in radiological departments, automation of routine activities has been little explored, while we found that in the last decade the interest of researchers has focused at the beginning on systems supporting decisions and business processes like GIS, ERP, EDI, MIS.

These studies are focused on implementation processes [18, 22, 29] and on temporal effects of the introduction of the systems on business processes and work activities [2, 19, 30].

A second wave of contributions has focused on virtual cooperation supported by groupware technologies. These contributions investigate the process of temporal coordination and the emergence of a temporal order in mediated communication environments [6, 23–25] and in one case the temporal perspective provides insights for the understanding of groupware calendar systems use [31].

In two recent contributions the issue of temporality has started to be investigated also in relation to mobile technologies. In one case with a focus on technology use and considering a variety of devices [26] and in the second case with a focus on the consequences of mobile phone use on the emergence of new temporal boundaries between work and nonwork activities [27].

Conclusions

The literature examined, which includes 15 papers (one theoretical and 14 empirical papers) covering in particular the last decade, has fully acknowledged the conceptualization of time as social construct, adopting theoretical frameworks derived from anthropological and sociological studies and from organizational culture research.

Among the frameworks adopted in empirical studies, those derived from anthropological studies [7, 8] have revealed to be particularly fertile, especially in order to investigate the consequences of technology introduction and use on the temporal organization of business processes and work activities.

As far as the epistemological standing is concerned, in the group of empirical papers examined there is so far a prevalence of constructivist and interpretivist perspectives compared to positivist approaches, which is not in line with the overall tendency in IS research.

It is interesting to point out that, as far as the research design is concerned, whatever the theoretical framework chosen, most papers examined do investigate the effects of IT on the temporal dimension in organizations (whether referred to business processes, worker's attitudes, communication and coordination processes, group dynamics, technology use) but very few papers have the explicit objective to explore the reverse direction of the relationship.

That is to say, still limited attention is paid to explore if and how assumptions on time and temporal orders (structures/cultures) existing in organizations affect the processes of implementation, use, interpretation of information technology.

References

1. Lee, H. and Whitley, E. (2002). Time and information technology: Temporal impacts on individuals, organizations and society. *The Information Society*. 18: 235–240
2. Taylor, F.W. (1903). *Shop Management*. Harper and Row, NY
3. Bluedorn, A.C. and Denhardt, R.B. (1988). Time and organizations. *Journal of Management*. 14(2): 299–320
4. Clark, P. (1985). A review of the theories of time and structure for organizational sociology. *Research in Sociology of Organization*. 4: 35–79
5. Ancona, D., Goodman, P.S., Lawrence, B.S., and Tushman, M.L. (2001). Time: A new research lens. *Academy of Management Review*. 26(4): 645–663
6. Orlikowski, W.J. and Yates, J. (2002). It's about time: Temporal structuring in organizations. *Organization Science*. 13(6): 684–700
7. Hall, E.T. (1983). *The Dance of Life: The Other Dimension of Time*. Doubleday, New York
8. Zerubavel, E. (1979). *Patterns of Time in Hospital Life*. The University of Chicago Press, Illinois
9. Merton, R. and Sorokin, P. (1937). Social time: A methodological and functional analysis. *The American Journal of Sociology*. 42(5): 615–629
10. Jacques, E. (1982). *The Form of Time*. Heinemann, London, UK
11. Giddens, A. (1984). *The Constitution of Society: Outline of the Theory of Structure*. University of California Press, Berkeley
12. Hofstede, G. (1991). *Cultures and Organizations*. Mc Graw-Hill, London
13. Schein, E.H. (1988). *Organizational Culture and Leadership*. Jossey Bass, San Francisco
14. Gherardi, S. and Strati, A. (1988). The temporal dimension in organizational studies. *Organization studies*. 9(2): 149–164
15. Butler, R. (1995). Time in organizations: Its experience, explanations and effects. *Organization Studies*. 16(6): 925–950
16. Barley, S.R. (1988). On technology, time, and social order: Technically induced change in the temporal organization of radiological work. In *Making Time: Ethnographies of High Technology Organizations*. F. A. Dubinskas (ed.) 123–169. Temple University Press, Philadelphia
17. Sahay, S. (1997). Implementation of IT: A time–space perspective. *Organization Studies*. 18(2): 229–260
18. Sahay, S. (1998). Implementing GIS technology in India: Some issues of time and space. *Accounting, Management and IT*. 8: 147–188
19. Lee, H. and Liebenau, J. (2000). Temporal effects of Information Systems on business processes: Focusing on the dimensions of temporality. *Accounting, Management and IT*. 10: 157–185
20. Schriber, J.B. and Gutek, B.A. (1987). Some time dimensions of work: Measurement of an underlying aspect of organization culture. *Journal of Applied Psychology*. 72(4): 642–650
21. Lee, H. (1999). Time and information technology: Monochronicity, polychronicity and temporal symmetry. *European Journal of Information Systems*. 8: 16–26
22. Scott, S.V. and Wagner, E.L. (2003). Networks, negotiations and new times: The implementation of ERP into an academic administration. *Information and organization*. 13: 285–313
23. Montoya-Weiss, M.M., Massey, A.P., and Song, M. (2001). Getting IT together: Temporal coordination and conflict management in global virtual teams. *Academy of Management Journal*. 44(6): 1251–1262
24. Massey, A.P., Montoya-Weiss, M.M., and Thing, Hung Y. (2003). Because time matters: Temporal coordination in global virtual project teams. *Journal of Management Information Systems*. 19(4): 129–155
25. Sarker, S. and Sahay, S. (2004), Implications of space and time for distributed work: An interpretive study of US-Norwegian sustems development teams. *European Journal of Information Systems*. 13: 3–20

26. Sorensen, C. and Pica, D. (2005). Tales from the police: Rhythms of interaction with mobile technologies. *Information and organization*. 15: 125–149
27. Prasopoulou, E., Pouloudi, A., and Panteli, N. (2006). Enacting new temporal boundaries: The role of mobile phones. *European Journal of Information Systems*. 15: 277–284
28. Failla, A. and Bagnara, S. (1992). Information technology, decision and time. *Social Science Information*. 31(4): 669–681
29. Sawyer, S. and Southwick, R. (2002). Temporal issues in information and communication technology-enabled organizational change: evidence from an enterprise system implementation. *The Information Society*. 18: 263–280
30. Kvassov, V. (2003). The effects of time and personality on the productivity of management information systems. *Proceedings of the 36th Hawaian International Conference on System Science* p. 256a. Track 8
31. Lee, H. (2003). Your time and my time: A temporal approach to groupware calendar systems. *Information and management*. 40: 159–164

Learning by Doing Mistakes Improving ICT Systems Through the Evaluation of Application Mistakes

M. F. Izzo and G. Mazzone

Abstract Last July, the University of Exeter, Great Britain, has empirically demonstrated how the human brain learns more from mistakes and unsuccessful events than from successful experiences. Memory, in fact, is more stimulated by mistakes and, after that, tends to generate a self-protection mechanism that, in a reaction period of 0, 10 s, warns of the existing danger. Starting from the article of Journal of Cognitive Neuroscience, we have tried to understand if the economic organizations, and in particular the ones that face IT implementation programs, act as humans. The purpose of this paper is to investigate how it is possible to invert a negative tendency or an unsuccessful IS implementation through the deeply analysis of mistakes and of their impact on value creation. In our proposal, the analyzed case study shows how a correct management of mistakes can generate value, through a "virtuous cycle of learning by doing".

Introduction

The concept of value creation is getting an increasingly important issue for economic agents [1–3], especially regarding all company life aspects that require higher investments and resources spending programs. In this sense IT investments recover a fundamental role in company efficiency research and, overall, in its strategic vision, enabling better decisional processes and promoting innovative and competitive initiatives that, for the success of the system, have to be monitored and implemented continuously. Specifically, we want to pay a particular attention to the organizational impact of this process [4], to understand, in the case of an unsuccessful program, the relations between mistakes and learning processes, according to the idea that in IS field there is more to learn from unsuccessful experiences than from successful ones (Dickson).

Università LUISS – Guido Carli, Roma, Italy, fizzo@luiss.it, gmazzone@luiss.it

The structure of the paper is as follows. Firstly, in section "ICT and Company Strategy", the relations between ICT and company strategy are discussed. Secondly, in section "IS Criticisms and Limitations", we will study concept and different definitions of errors and the relationship with the idea of "learning by doing mistakes". Moreover, in section "Case Study: Luiss Library", we will analyze the Luiss Library (LL) case study in order to verify our thesis. At the end we will present our conclusions about the potential knowledge hided in mistakes also according to LL case.

ICT and Company Strategy

IS Life Cycle

Several researchers [5] highlight how the traditional theories about new technologies development, ICT investments appear often inadequate.

In this context, we have the necessity to search IT development methodologies that, starting from IT competitive strengths model (for deepening, [6, 7]) and from all criticisms linked to existing management, generate new IT value for company.

Information systems are not rigid, static and unchanging. They evolve with external and internal environment. The process of IT introduction in company can be observed like a sequence of activities: (a) individuation of company needs; (b) conversion in IT needs and specifics; (c) configuration of architectures; (d) construction of system and other sequential activities.

The advantages offered by recognizing an "evolving nature" of company information systems are constituted by the following activities:

- To organize groups and core competencies [6, 8] required by different steps about development and test of information system
- To recognize the possibility to manage both existing IT system and new development IT projects, because several literature reviews show that ICT investments are more oriented to manage existing that to develop new
- To follow company business and to support company activities. In this sense IT and company strategy are linked through a bi-univocal relationship

Traditionally, theories of information systems introduce different steps of implementation, from analysis of needs to realization of system [9, 10]. In an "evolved perspective", Laudon and Laudon [7] represent IT implementations like a "life-cycle". The last step at this cycle regards "production and maintenance of IT system" that is, in our vision, the most critical to start a learning process based on mistakes.

From IT Governance to IT Evaluation

Top management's support towards information systems realization is crucial [1, 7] because it involves the correct functioning of IT life cycle: setting goals and appraising objectives, evaluating projects, defining information and processing

requirements and reviewing programs and plans for the information system effort. This phenomenon is known as "IT governance" that involves an efficacy and efficient alignment between IT and company needs.

IT governance involves different approaches:

- Intervening "ex-post", when existing IT system or applications don't perfectly work. In this case, company strategy involves an IT problem solving focus, that absorbs time, and obstructs the possibility of new IT development. We can speak of "existing management"; this tendency is confirmed by an analysis conducted in 2005 about ICT investments [1]: 92% of costs are finalized to existing management and upgrade; only 9% represents costs of new projects implementation.
- Intervening "ex-ante", in order to realize a strategic master plan, that begin from an analysis of needs, implementation of system, until evaluation process. In this sense, we can define "IT evaluation" as a system of measures necessary to monitor IT system performance, that offers the possibility to change the route "just in time", when system fails. In a IS governance view, IT evaluation represents a key-item to gain company success.

IS Criticisms and Limitations

Designing IS. Plan, Practice and Mistakes

The typical trade off existing in each planning activity, and verifiable also in the IS designing and programming experiences, has to do with the opposition between idea and practice, between planning and realization, between intended consequences and unintended consequences. A mistake can regard (a) the final objective; (b) the path covered to reach the objective or (c) the communication activities and all that has to do with the perception of the users. Obviously, each category (a, b or c) has different declensions (evaluation users needs/requirements; IS design, coherence between objectives and company economic/organizational possibilities; evaluation of personnel skills; implementation program; definition of intermediate objectives, and so on) that lead to different results (decreases in profits, budget overruns, high costs of ownership and disappointing performances and lack in participation), but the common idea is that HIATUS between plan and results exists.

The literature about IS and implementation mistakes (for an historical overview see [11]), underlines the existence of different categories of errors, depending on the perspective adopted. Ravagnani [12] classifies the methodological causes of organizational failures linked to IS in: (a) relational problems between designers and users; (b) incoherence between programming logic and organizational structure; (c) undervaluation of interdependencies between technical and organizational design; (d) misunderstanding of users needs. De Marco [9] identifies five types of errors than can compromise the IS application results: (a) operative error; (b) economic error; (c) technical error; (d) development error and (e) priority error. Whatever the mistakes, to face them, the strategies developed by a company change

according to the company approach to control, risk and the ontological idea of mistake. The companies that assume what we call an Enlightenment approach, are convinced that, with the deep control of each activities and responsibilities of everyone, it is possible to eliminate errors and risk. On the contrary, we call the companies that recognize that mistakes are to a certain extent unavoidable and a normal part of technology implementations, pragmatic companies. Scott and Vessey [13], i.e., believe that failure, at some level, or in some areas of implementation, is inevitable; Schwartz Cowan [14] defines the failures inevitable as death and taxes.

Learning Process. A Virtuous Cycle

According to an iterative implementation approach about the evolving nature of IS, the phenomenon of feedback (opened or closed), jointed to a flexible concept of organization changes, contributes to stabilization of process and leads to a virtuous cycle of knowledge and consciences that can represent a competitive advantage enabler. In this paper we deal with the issues of doing mistakes during implementation process and with the idea that it's possible to learn from mistakes, exploiting a sort of experience economies. A company that encounters obstacles, like a ship, starts drifting [15, 16]; if facing these obstacles and mistakes, it translates them in knowledge and experiences a virtuous cycle arise and we call this phenomenon "virata" (veer). In other words, what before was an obstacles, became a key for the success.

Case Study: Luiss Library

Rome, Via Pola 12, Luiss Bar,../../2003.

Student A: "Did You go to library yesterday? How it was?";

Student B: "Not so good! Not very helpful staff, unordered location and slow service!"

Rome, Via Santa Costanza 53, Luiss Library, 31/07/07.

The head of library, Ms Villagrasa remembers that moment as a "new day one" in order to totally change strategic view of Library structure and offered services.

Why? Understanding Mistakes

LL was born in the 1970s, to support research activities of Luiss University, with a rich heritage, essentially arranged of monographs, already notable. Nowadays, after more than 40 years, LL is one of the most important Italian university libraries, finalist in 2007 at the Moebius Prix. This is the result of a long path, with a lot of investments in innovation and organizational changes, that led to a structure that presents about 22,000 electronic resources, about 152,000 hard heritage, about 6,300 potential users, etc. LL was historically careful of technological innovation

but without a clear definition of strategic view and primary objectives, neither of an implementation and sharing plan. Trying to simplify, the most critical aspects recognized as change management area can be divided in "organizational/service errors" that correspond to difficulties in facing external relationship and in offering the most attractive service; "technical errors", which have to do with the undervaluation of logistics or other functionalities of LL system. Moreover, there were "communicational errors" that involve the absence of evaluation process and the incorrect way to face the users. Finally, we have individuated "Human Resource errors", caused by a vertical and too hierarchical organization, incapable to create into the team the awareness of being a part of a system. Furthermore, there were no knowledge exchange between different people that worked side by side, and no consciousness about LL growth possibilities ("they didn't know what they didn't know").

From Patchwork to Network

Analyzing this situation it appears like a "patchwork", a whole of right and wrong different things, skilled people in incorrect places, potential resources of competitive advantages mismanaged and without an unique organization. For example, the information system bought by Luiss was competitive and strongly innovator, but in English language (and frequently LL personnel didn't know very well technical English) and with a lot of not shared applications. Moreover, the back office personnel was really skilled but deeply consciousness only of a part of the system and never in touch with the final users. The first (and unique) criticism of LL dysfunctions, perceived by Luiss Administration and communicated to new Head of Library, was the intrinsic difficulty of the IS Amicus, firstly introduced in 2000. In this sense, so, the administrative advice was to change the software. The approach of the new Head of Library was totally different: to maintain the (expensive) software, to educate employees and users and to share all the knowledge disperse in the different sectors by the definition of a clear and articulate program of both user needs and service results evaluation. The passage from patchwork to network-organized elements that tend to a shared objective and that work effectively together occurred in 2002 and was represented by the design and the communication of a formal strategic plan that regards the two main services offered by LL: traditional services and on line services. The milestones of this plan were: (a) HR Reengineering: horizontal organization, personnel rotation plan, investment in improving skills and stage programs, creation of positive organizational climate; (b) Technical Innovations: new and more functional web site, "Sala Reference" program, enlargement of services and logistics reorganization (i.e. RFID project that will allow more effective services: anti-theft, electronic inventory and self-loan programs); (c) Organizational Changes: continuous implementation of LL strengths points, users and staff evaluation programs, statistics of accesses, daily relationship and joint implementation work with the web-master and growing budget invested in users requirement satisfaction; (d) Communicational Activities: organization of LL training days with the purpose of educate all the users, realization of cultural activities (art laboratory,

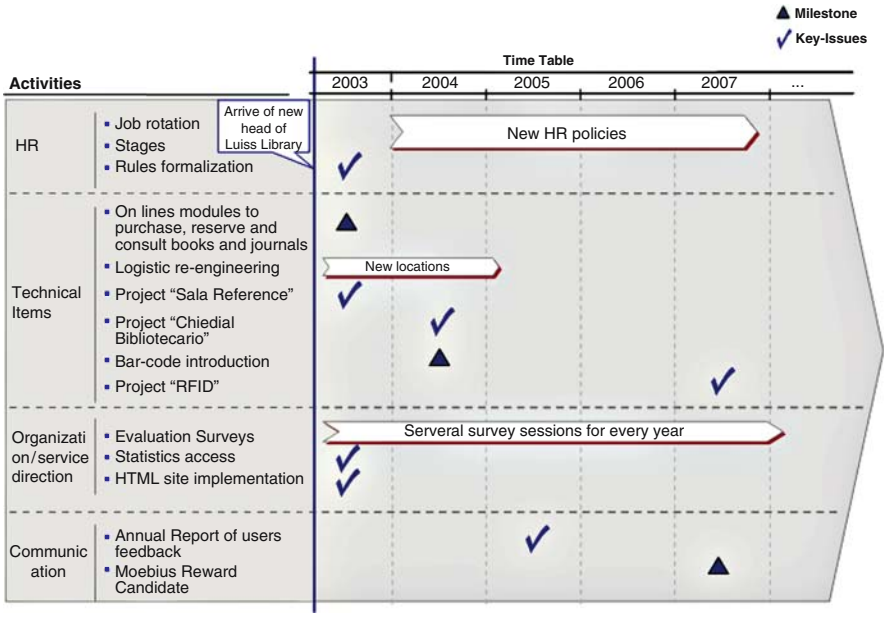


Fig. 1 LL History (2003–now)

photograph courses and shows), promotion (Luiss White Night) and investment in LL image (Moebius Prix, i.e.) (Fig. 1).

At the end of this process, we have observed a new trend of most important monitored indexes: from 2003 to 2006, the e-journals downloaded articles grown up of 529%, the data banks log on of 862%, the monograph reference of 482% and the interlibrary loans of 288%. A key issue of new LL trend was the service evaluation process, that started in 2003 with users satisfaction questionnaire designed to understand users needs and define the areas of growth of entire Library System. LL Survey, for the year 2007, shows a positive square satisfaction of 4.15 (on a maximum of 5), that represents the better result since the evaluation system introduction. But, as Mrs. Villagrasa says, the process of LL renew is not completed…"The results of questionnaires are optimal, but it doesn't mean that I want to stop to do them!".

Conclusion and Further Implementations

This paper starts from the idea that also a good company, that has competitive resources, infrastructures, team and knowledge, can fail the mission if it doesn't analyze its mistakes and organize the results in a structured implementation plan.

For consequence, we have analyzed and tried to isolate the conditions that can transform an unsuccessful history in a successful experience. After, we have underlined that mistakes can have a "learning aim", if it become a guideline for change

the route. The LL case show how a correct management of mistakes can generate value and allows the complete accomplishment of strategic tasks firstly missed.

Further implementations of our analysis could then related:

- To a more detailed definition of the "learning by doing mistakes" process
- To the extension of the analysis to more cases in an extended time horizon
- To the use of a more sophisticated quantitative methodology of treating the available data

References

1. Gandolfi, G. & Ruozi, R. (2005). Il ruolo dell'ICT nelle banche italiane: efficienza e creazione di valore. Bancaria Editrice, Milano
2. Costa, G. (2001). Flessibilità e Performance. Isedi, Torino
3. Jensen, M.C. & Meckling, W.H. (1976). Theory of the firm: Managerial behavior, agency costs and ownership structure, Journal of Financial Economics, 39: 1021–1039
4. D'Atri, A. (2004). Innovazione organizzativa e tecnologie innovative. Etas, Milano
5. Martinez, M. & De Marco, M. (2005). Sistemi Informativi a misura di organizzazione. Il contributo delle teorie di organizzazione . . ., in Organizzare a misura d'uomo. Università Cattolica del Sacro Cuore, Milano
6. Porter, M.E. (1985). Competitive Advantage. The Free Press, New York
7. Laudon, K. & Laudon, J. (2006). Management Information Systems, 9th edition. Pearson Prentice Hall, Upper Saddle River, New Jersey
8. Prahalad, C.K. & Hamel, G. (1990). The core competence for the corporation, Harvard Business Review, 26: 1
9. De Marco, M. (1986). I Sistemi informativi aziendali. Franco Angeli, Milano
10. Vinci, M. (1992). Analisi Costi Benefici dei Sistemi Informativi Aziendali. Siderea, Milano
11. Sauer, C. (1999). Deciding the Future for IS Failures: Not the Choice You Might Think, in Rethinking Management Information Systems, W.L. Currie and B. Galliers (eds.). Oxford University Press, Oxford
12. Ravagnani, R. (2000). Information Technology e gestione del cambiamento organizzativo. Egea, Milano
13. Scott, J., & Vessey, I. (2003). Implementing Enterprise Resource Planning Systems: The role of Learning from Failure, in: Second-Wave ERP Systems. Cambridge University Press, Cambridge
14. Schwartz Cowan, R. (1990). The Consumption Junction: A Proposal for Research Strategies in the Sociology of Technology. MIT Press, London
15. Winner, L. (1977). Autonomous Technology. Technics-out-of-Control as a Theme in Political Thought. MIT Press, London
16. Ciborra, C.U. (2002). The Labyrinths of Information. Oxford University Press, Oxford

Innovation, Internationalization, and ICTs: Mediation Effects of Technology on Firms Processes of Growth

L. Marchegiani and F. Vicentini

Abstract As *innovation* and *internationalization* have increasingly gained importance as core strategies in the processes of growth of firms, it becomes also relevant in the managerial studies related to ICT and to information systems to understand whether such technologies may influence the outcome of these strategic paths. This study focuses on the relevance of ICT adoption in fostering knowledge accumulation, with specific respect to international markets and innovation efforts of firms, and thus in influencing the growth of the international firms.

Introduction

Innovation and internationalization are considered among the most relevant issues from a sustainable competition perspective. This is true both with respect to the single firm's process of growth, and from a whole systematic approach. Thus, it is more and more relevant to deploy studies on the critical issues around such strategies, with particular emphasis on the Small and Medium Enterprises (SMEs). It is furthermore relevant to deepen the analysis on the linkages between internationalization and innovation. In fact, it is still unclear whether a clear path of reinforcement could be observed when firms pursue both strategies. Moreover, it is interesting to analyze whether mediation effects could be addressed on the adoption of advanced technologies.

Luiss Business School, Roma, Italy, lmarchegiani@luiss.it, fvicentini@luiss.it

Theoretical Background: The Linkage Between Innovation, Internationalization and Tacit Knowledge

Economic globalization is generally accepted to imply the growing interdependence of locations and economic units across countries and regions. In this process the primary driving forces are the technological and the increasing significance of multinational enterprises. In this context, the new approach to MNEs and innovation has drawn heavily on an evolutionary view of the firm and the industry [1], examining the accumulation of technology within the international networks of MNEs as a *path-dependent* corporate learning process [2, 3]. In order to exploit this approach, we embrace a different perspective in considering the technology transfer, being concerned with its interaction with learning processes and not just with the immediate exchange of knowledge (Fig. 1).

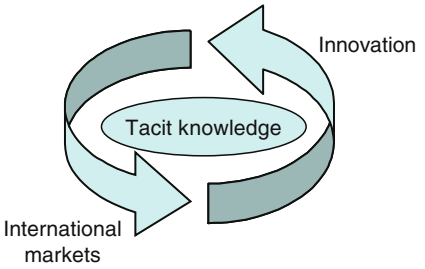


Fig. 1 Theoretical framework

In this paper, we focus on the *tacit* element of technology, that results embodied in the organizational routines and collective expertise or skills of specific production teams. It implies that a firm can imitate the tacit capability of another, but it can never copy it exactly since the learning experience of each firm. In this perspective, the key indicator of inter-firms differences in terms of potential is the ability to generate tacit capability. The tacit nature of technology implies that even where knowledge is available through markets, it still needs to be modified to be efficiently integrated within the acquiring firm's portfolio of technologies. In addition, the tacit nature of knowledge associated with production and innovation activity in these sectors implies that "physical" or "geographical" proximity is important for transmitting [4]. The knowledge transfer process is highly costly and to improve this negative peculiarity it is necessary creating and enhancing spillovers that can facilitate the exchange of knowledge. The innovative aspect of this approach that we consider strictly important for this research is the establishment of international networks; entering in one of these networks enhances the joint learning process in order to raise the rate of innovation inter-firms and hence, their technological competitiveness. The notion of an active interchange between parts of a MNEs have adopted internationally integrated strategies in a number of industries [5, 6]. Complex linkages, both within the firm, and between external networks and internal networks, require complex coordination if they are to provide optimal [7].

If the external technology development is primarily the domain of larger firms with greater resources and more experience in transnational activity [8], it is also

true that small firms can have a higher level of flexibility, that can reveal high innovative potentialities.

In conclusion, firms – regardless of size – must maintain the appropriate breadth of technological competences, and to do this they must maintain complex international internal and external networks.

Hypothesis: The Mediation Effects of Technology on Firms' Processes of Growth

The study builds on the literature described above, with the aim of identifying the conceptual linkage between internationalization, innovation and ICT adoption, the latter being considered a facilitator for tacit knowledge accumulation. In this perspective, the adoption of information and communication technologies, and of advanced information systems, should foster knowledge accumulation and ultimately lead to faster processes of growth.

More in details, the research attempts at verifying the following hypothesis.

Hip (1): in firms with significant operations abroad, which we call international firms, the ICT adoption and usage have a positive impact on the propensity to innovate (Fig. 2).

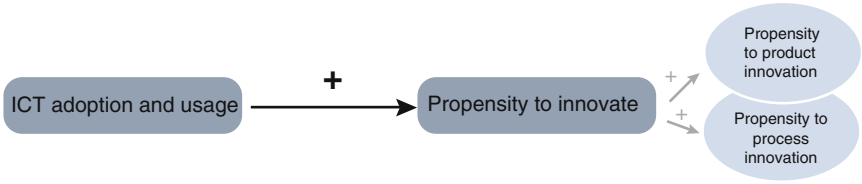


Fig. 2 Hypothesis 1: ICT adoption and usage and propensity to innovate

Hip (2): in international firms, the adoption of innovative technologies has a positive impact on the performances bound to innovation, which are measured through the items: the impact on turnover from innovative products; the number of patents; and the royalties from registered patents (Fig. 3).

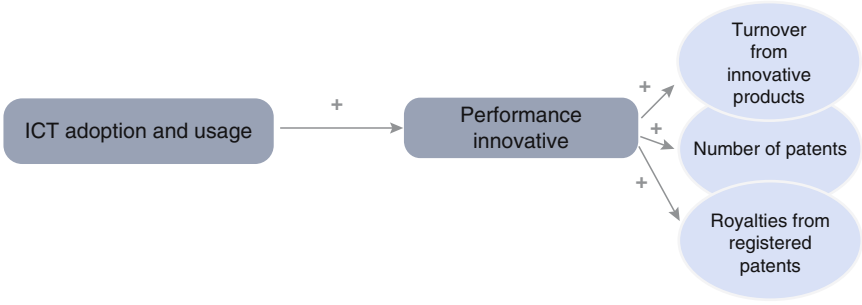


Fig. 3 Hypothesis 2: ICT adoption and usage and innovative performance

The hypotheses have been tested through the selected variables and items, which are depicted in the analytical framework, as shown below.

More in details, we identified the variables *internationalization, innovation, and ICT adoption and usage*. As for the internationalization, we measured the degree of operations developed abroad, by means of international turnover and sales. The innovation has been measured through issues such as R&D investments, international patents, flows of royalties from registered patents, and turnover from innovative products. The ICT adoption and usage has been tested verifying the use of e-mails, e-commerce, e-procurement, e-banking, e-bidding, ERP, Supply Chain Management, and e-logistic (Fig. 4).

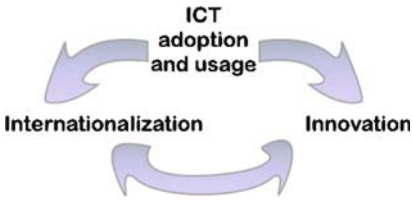


Fig. 4 Analytical framework

Empirical Setting

We conducted a survey testing the variables described over a sample of 500 firms with international and innovative activities. They are mainly Italian SMEs, and the respondents were either Executive Officers or General Directors, with a response rate of 100%. The firms in the sample have shown significant values of both the internationalization and the innovation dimensions, with respect to variables selected to measure the depth of the international activities and the breadth of the innovation efforts. In conducting our summary statistics, we split the sample according to whether firms realized product or process innovations, or else whether they have relevant international activities. Thus, measuring whether or not the firm has innovated in the past five years is a flow measure of innovation. Our data allows comparing the performance of different variables. In order to do this, it is important to highlight the following aspects:

- The international firms observed have reached a significant competitive position in the international markets in a relative short period of time: 45% of the interviewed firms state that the market has been successfully penetrated in less than 5 years: it means that product innovations and processes innovations dominate in the early stages of the product and industry life. Especially for firms located in smaller countries, this implies that exports should be positively affected, as demand in the domestic market is not well developed yet and firms discriminate between domestic and international markets for these novel products for which they have some market power. Different activities such as own R&D, the acquisition of technology on the external technology market and cooperation in R&D

are complementary activities in the innovation process. Therefore, firms combining these different activities are expected to be better performing in their export activity.

- The firms observed have been able to grasp the opportunities of the international market, raising their overall economic performances: a significant difference is confirmed between the internal and the international profitability ratios.
- The use of ICT applications is widely diffused among the sample of firms and it reveals a positive effect on innovation and internationalization, behaving as driver of a retroaction circuit.

Results and Conclusions

Among the statistic analyses that we performed on our sample, it is important to stress here the regression models that allow confirming the mentioned hypotheses. As shown in Fig. 5 below, there is a significant positive effect of the ICT adoption and usage on the innovation index.

The figures show that the regression model is statistically significant, and there is a high correlation between the usage of ICTs and innovation. In fact, the Innovation index is defined as the firms' capacity to introduce either product, process, or organizational innovations over the past 5 years. This means that for those firms whose rate of adoption of innovative Information Systems, the propensity to innovate reflects also on the capacity to bring innovations into the markets where they compete. With respect to international firms (50% of the whole sample), the regression model is even more significant (R squared is equal to 0.352, β is equal to 0.593 with a Sig. of 0.000). This result shows that the higher the level of confidentiality that international firms have with innovative Information and Communication technologies,

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1,	577(a)	0,333	0,332	0,31264

a Predictors: (Constant), ICTindex

ANOVA(b)

Model		Sum of Square	df	Mean Square	F	Sig.
1	Regression	24,296	1	24,296	248,569	,000(a)
	Residual	48,676	498	0,098		
	Total	72,971	499			

a Predictors: (Constant), ICTindex
b Dependent Variable: INNindex

Coefficients(a)

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	1	0,014		71,523	0
	ICTindex	0,221	0,014	0,577	15,766	0

Fig. 5 Regression model Innovation index – ICT index

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	,372(a)	0,138	0,135	0,12981

a Predictors: (Constant), ICTindex

ANOVA(b)

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	0,669	1	0,669	39,711	,000(a)
	Residual	4,179	248	0,017		
	Total	4,848	249			

a Predictors: (Constant), ICTindex
b Dependent Variable: Impact

Coefficients(a)

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	1,011	0,008		119,932	0
	ICTindex	0,057	0,009	0,372	6,302	0

a Dependent Variable: Impact

Fig. 6 Regression model turnover from innovation – ICT index

the higher their attitude to innovate. This would also impel that a deeper penetration of information systems within international SMEs would ignite positive effects on their overall degree of innovation, thus leading to higher levels of investment in research and development.

In order to test hypothesis 2, on the other side, these figures must be compared to those showing the impact of ICT adoption and usage to innovative performances. Accordingly, we have constructed the Impact Index, which measures the impact of innovation on the firms' turnover, their ability to register patents and to gain royalties from them. A regression model has been then tested only for the international firms (50% of the sample). As shown in the regression in Fig. 6, though a positive effect could still be observed, the results are positive to a lesser extent. In fact, a moderation effect might occur, which mitigates the positive impact that ICT adoption and usage has on the output of the innovation activities of firms.

In conclusion, combining the results it is possible to argue that there is a conceptual linkage between innovation and internationalization of firms, and this is indeed emphasized when firms have an enthusiastic attitude towards ICTs and IS. This would also allow to state that a deeper confidentiality with innovative information system applications to support the processes of internationalization and of innovation would lead to better performances on the markets where those firms compete. Thus, it is possible to conclude that technology, if well managed and integrated in the overall strategy of firms, could successfully support their processes of growth.

References

1. Nelson, R. R. and Winter, S. G. (1982). *An Evolutionary Theory of Economic Change*. Cambridge, Harvard University Press
2. Cantwell, J. (1989). *Technological Innovation and Multinational Corporations*. Oxford, Blackwell

3. Cantwell, J. (1991). The Theory of Technological Competence and its Application to International Production, in D. G. McFetridge (ed.), *Foreign Investment, Technology and Economic Growth*. Calgary, University of Calgary Press
4. Blanc, H. and Sierra, C. (1999). The International of R&D by Multinationals: Trade-off between external and internal Proximity. *Cambridge Journal of Economics*, 23, 187–206
5. Granstrand, O. (1979). *Technology Management and Markets: An Investigation of R&D and Innovation in Industrial Organization*. Göteborg, Svenska Kulturkompaniet
6. Granstrand, O., Hâkanson, L., and Sjolander, S. (1992). *Technology Management and International Business: Internationalization of R&D and Technology*. Chichester, Wiley
7. Zanfei, A. (2000). Transnational Firms and the Changing Organization of Innovative Activities. *Cambridge Journal of Economics*, 24, 512–542
8. Castellani, D. and Zanfei, A. (2003). Technology Gaps, Absorptive Capacity and the Impact of Inward Investments on Productivity of European Firms. *Economics of Innovation and the New Technology*, 12(6), 1

The "Glocalization" of Italcementi Group by Introducing Sap: A Systemic Reading of a Case of Organizational Change

A. Martone[1], **E. Minelli**[1], **and C. Morelli**[2]

Abstract The Italcementi case is a paradigmatic example of how a technological innovation process can lead to overall change of a firm's organizational and value creation model. The success of the process does not lie so much in the validity of the technological solution, but rather in the ability to manage the change process itself, the main pillars of which are the learning of new techniques and new business models, the correct management of power, the development of technological, financial and knowledge resources.

Introduction

Some caution should be used in aiming to draw up a general model for the analysis and interpretation of the change process. It is difficult and arbitrary to draw general conclusions, particularly in terms of devising "laws" or "general theories", or in purely normative terms, given the possible variations and changing nature of the situations that may be hypothesized and the many multidisciplinary aspects that must be taken into consideration. However, it is useful to apply a paradigm of analyses to real cases facilitating a systemic reading of organizational change in order to achieve an interpretation of the evolution of events that can afford critical reflection and useful indications to guide management in the decision-making process.

This paper aims to analyze the Italcementi case by applying the model of systemic analysis of the organizational change process put forward by Rebora [1, 2]. This reference framework highlights the critical variables and the relations between them, making it possible to identify the areas and levers for action guaranteeing a positive management of the process. The model breaks the change process up into

[1]LIUC Università Carlo Cattaneo-Castellanza, Varese, Italy, amartone@liuc.it, eminelli@liuc.it
[2]LIUC Università Carlo Cattaneo-Castellanza, Varese, Italy and Università del Piemonte Orientale, Italy, cmorelli@liuc.it

sub-processes by means of an analytical approach that identifies the following variables:

- *The drive towards change*: These forces incite evolution of the organizational forms and arise from the relationship between the firm and the outside environment. However, they are not in themselves enough to initiate and feed the evolutionary process and are blocked by organizational inertia.
- *Organizational inertia*: This is the tendency to preserve the existing organizational set-up, even when this is clearly highly inefficient. This tendency to stability and continuity, which is characteristic of any kind of organized system, both hinders change processes and tends to divert them towards particular actions or objectives.
- *The change agents*: These are actors who can promote the change process within the organization. In fact the drives do not determine the development of the change process; the potential energy they generate must be converted into a concrete course of coordinated actions and positively channeled towards a result that is coherent with the change objectives via the contribution of individuals who can influence the interactions that are critical for the evolution of the corporate system.
- *The change processes*: These are the sequence of actions and interactions by means of which the evolution of a company takes place. These actions identify the different sub-processes within the overall process that are initiated by the drive factors and the action performed by the change agents in order to overcome the conditions of inertia. They can be divided into the following main sub-processes:
  - The learning process, which refers to the change in knowledge, inter-personal relations and shared values
  - The organizational development process, which involves the overall system of human, technical and financial resources
  - The power management process, which oversees the system of interests and influences
  - The overall management and coordination of the sub-processes, within which the evolutionary process of the corporate system takes place

If well managed, the sub-processes can develop a trend which is self-perpetuating and growing, reinforcing the drives and activating the agents in a virtuous circle. Specific modes and tools are linked to the sequence of actions and interactions, by means of which the actors can influence the evolutionary process of a firm.

- *The levers activating the change process*: These are the tools and practices that the change agents can activate to guide and manage the change process. They are specific to each sub-process and are determinant for the outcome of the process.
- The outcome and results of the organizational change: These are the new profiles that emerge in the different areas of the company as a result of the change process.

Organizational change is one aspect of the wider process of a firm's transformation, which involves the technical aspect, the strategies and the institutional aspect. The

empirical analysis of the Italcementi Group case investigates the relationship between the processes of development of resources, of learning and of management of the power systems, in order to understand their direction and coherence and highlights the importance of processes of resources development in the management of organizational change. The methodology for the investigation is based both on the analysis of secondary sources (internal documentation, reports etc.) and, more widely, on interviews with company managers involved in the change processes described.

The Critical Circuit: Learning-Power-Resources

From a systemic perspective we can draw a synthesis of the essential processes of organizational change [3]. These three processes move in different ways; nevertheless they inter-relate and condition each other reciprocally producing a single outcome. They are the processes of learning, power management and the development of organizational resources. An organization is no more than a system of resources, in the sense that it is the resources, the activities or the core critical capacities that determine the success of the firm but also pose limits on the change process. The introduction of innovative projects thus has to face the problem of an adequate set up of company resources in terms of technology, financial resources, capacity and knowledge incorporated in the structure and the personnel [4]. This aspect has various interpretations in organizational theory. The resource-based view of the firm considers that differences in the quality of resources lead to differences in company performance [5–7]. Evolutionary economics [8] maintains that the abilities and capacities of the firm are defined by the environment created by the routines drawn up to carry out organizational tasks. Other studies, such as those regarding the ecology of organizations [9, 10] to the role played by specific investments, both in terms of technology and plant and in relational terms, in conditioning and limiting the firms capacity to adapt.

The Italcementi Group case is evidence of the importance of the concept of resources development for a change process. International expansion is the result of the need to diversify risk in a stable sector where the greatest growth rate is in developing countries. The success of an international group in this field demands strong integration and spread of the management practices that prove to be the most efficient. "World Class Business" is the group's slogan. Italcementi is a firm that was founded in the nineteenth century and which has been able to renew and re-launch over time. Overseas expansion via acquisitions has been the constant strategy since 1992, when Ciments Français was taken over with a move that took the markets by surprise for three reasons: it was the biggest takeover of a foreign company by an Italian group, the biggest increase in capital (5 billion old French francs, equal to 725 million euros) carried out on the French Stock Exchange and the largest increase ever recorded for an Italian industrial firm, which grew from a pre-takeover turnover of 1,500 billion lira (775 million euros) to a consolidated turnover of over 5 trillion

lira (2,582 million euros) for the new group. Following growth in Eastern Europe (Bulgaria), Kazakhstan and Thailand, the group went into India, which was the third largest world market for cement. The birth in 1997 of "Italcementi Group" incorporating all the firms in the group signaled a new strategy of internationalization, whose main themes were: diversify the risk by progressively going into emerging countries, encourage group integration by creating a shared identity at international level, generate synergies wherever possible. Today, Italcementi Group is the biggest cement producer and distributor in Europe and one of the leaders in the world market. The decision to internationalize led to the re-examination of Italcementi's consolidated organizational model in a new perspective of long-term efficiency at group level. Although the Italian management model was valid, the company management decided to exploit any positive experience in the firms they took over, in this way creating the opportunity to reconsider the Italian model. The firm was entirely rethought out in terms of processes, at a time when the organizational model of the individual firms was predominantly functional. Thus the development of internal resources took on primary importance for the realization of the strategic objective of the creation of the group: "World Class Local Business" was its slogan. From the start the objective was to share know-how in technology management; to this end the technical management and the research centers of Italcementi and Ciments Français were merged in the Group Technical Centre. The two very different firms thus began to merge into one starting from their know-how. Technical skills were put in one basket to the mutual benefit of all the group. The next step was to understand the need to re-assess all business processes and promote change with the idea of harmonizing solutions and processes rather than imposing them from above. Thus a feasibility study was carried out in 95–96 in order to harmonize processes. The study started from the bottom, in order to bear in mind the type of organizational system, processes and technology adopted in each country. It also aimed to verify the compatibility with solutions offered by technology. SAP was thus identified as a central tool for harmonization, given that at the time ERP was the most stable system and guaranteed greater reliability for the future, promising the recovery of overall efficiency by means of the spread of best practices within the whole group. SAP did not in itself require internal re-organization, nevertheless its introduction was the opportunity for re-organization. Thanks to these rapid steps the group's top management was able to promote a clear and ambitious aim: to create a highly developed rational organization, distinct from previous experiences, even positive ones, an organization that was totally new and in keeping with the international status acquired by the group. In the years following 1997 the SAP project became consolidated thanks to this aim to develop the "organization" resource. It was not so much the technical features of the integrated IT system that made it a success, in fact the system's limits immediately became clear and substantial corrective action was later needed. Nevertheless, the introduction of SAP represented a lever to mobilize the different energies present in the individual company units, bringing them together in one great project to create a single unified group. In less than 14 months the nucleus (kernel) was developed (November 1997–June 1998) and adapted to local needs of every country involved (June–December 1998). On January 1st, 1999 the solution became operative for the Belgian, Greek, French, Italian, North American

and Spanish firms. In a second phase SAP was extended to the other countries in the world. The project kernel contained all fundamental company processes developed to different degrees. The most complete was the maintenance process, which represented the core of benefits and strategic harmonization. The process highlighted the need to re-define roles and duties giving the opportunity to greatly improve efficiency, even though, obviously, during the transition period more resources were needed to cope with the increased work load connected with the change. The process of development of company resources, including physical-technical, economic, IT, intellectual and relational resources, cannot be isolated from other aspects of the overall flow of organizational change, that is to say the processes of learning and power management. In Italcementi, the preparation for change soon proved to be crucial; it was immediately obvious that the problem was not to create new solutions (technical and organizational) but to prepare for change by involving all the interested parties as soon as possible. The project (called Spiral, in clear reference to the new group logo and to underline the continuity of the change process) had a significant technological component but it was with the successful involvement of the personnel that the fundamental key to success lay. The preparation for the new organizational plan had been very carefully made, at least on paper, but there were still errors. Learning took place mainly through training: before the new solution was ready, all those who would be either directly or indirectly involved were prepared for the change by means of seminars, internal publications, internal communication actions. This phase involved everyone in turn over a period of about 1 year with not less than 8 days per person and took place before the technical-operational phase of training on setting up the final solution. The most intensive part was obviously this final phase when the solution was ready. The greatest problems were experienced where the preparatory training was lacking. The development of resources in the way indicated thus requires an intense parallel commitment to generate learning processes, in terms not only of knowledge but also of operational styles and inter-personal approaches on the part of the different individuals working in the organization. From the point of view of the power management, the entrepreneur, in the person of the CEO (Gianpiero Pesenti) was the main sponsor and supervisor of the venture. By naming Carlo Pesenti (representing the new generation) Project Director, he underlined the strategic importance of the project and explained his vision: the project could not fail, inasmuch as the very future of the company was linked to it. This message was strengthened thanks to the identification of Process Owners, who were authoritative and credible figures with a clear role in the future of the Group. The members of staff most directly involved in the project (and thus closest to the daily operational decisions) then took on an important role over the years.

Conclusions

In reality no technical project can really contribute to improving corporate assets or generating real organizational change if it is not accompanied by learning processes. In this case the introduction of complex IT systems has important consequences for

company operators at all levels. Not only must they assimilate new technical know-how, but they also have to modify previous models and behaviors. In a large organization this means recourse to intense and widespread training and also to mediation by specialized consultants, who are present for long periods alongside the operational structures. But learning does not take place in such a linear and sequential way; the commitment to real life learning processes soon shows that during their implementation sophisticated technologies can reveal hidden defects or unforeseen problems with regard to the original objectives or even compared to the potential benefits originally outlined by the suppliers. Technological solutions also have to be corrected, important aspects re-planned, which all adds up to a patient and widespread effort of adaptation. Learning interacts with development of resources, contributing to generate a positive result, even though this means asking the firm to bear higher costs than those originally estimated. But this alone is not enough; the success of such wide-ranging innovation processes demands actions that are congruent also in the area of power management. Obstacles, difficulties, costs of change do not prevent the objective being reached because a strong movement towards change and, at any rate, favorable conditions are present also at management level. The project is supported personally by the company head, the entrepreneur, who retains firm control of company ownership, delegating the project leadership to his son, who, as his designated successor, represents the future of the company.

The process of development of corporate resources sets up a virtuous circle and leads to the benefits inherent in organizational change, as in the Italcementi case, with harmonization of IT systems, integration of all the firms in the group, promotion of collaborative and pro-active behaviors on the part of the personnel at all levels, with consequent positive influence on economic/financial results and in terms of competitiveness. However, it is inconceivable that this development should take place without the virtuous circle being fed by shared learning processes that are stimulating and not mere routine and without it being given order by an appropriate management of the power system. In the example given the critical circuit not only shows coherence between its fundamental components giving energy to the change process, but also takes on positive value from the point of view of reading the results in terms of company objectives. A positive outcome not only in terms of the achievement of what was programmed but which goes beyond that, offering the company a greater potential for innovation than that inherently implied in the strategy formulated.

References

1. Rebora, G. (1988), Il cambiamento organizzativo nelle amministrazioni pubbliche, *Azienda pubblica*, 1
2. Rebora, G. (2001), *Manuale di organizzazione aziendale*, Roma, Carocci
3. Rebora, G. and Minelli, E. (2007), *Change Management. Come vincere la sfida del cambiamento in azienda*, ETAS, Milano
4. Ansoff, H.I. (1984), *Implanting Strategic Management*, Prentice-Hall, Englewood Cliffs

5. Teece, D. (1998), Capturing value from knowledge assets: The new economy, markets for know-how and intangible assets, *California Management Review*, 40(3), 55–79
6. Barney, J. (1991), Firm resources and sustained competitive advantage, *Journal of Management*, 17, 99–120
7. Prahalad, C. and Hamel, G. (1990), The core competence of the corporation, *Harvard Business School Review*, 68(3), 79–93
8. Nelson, R.R. and Winter, S.G. (1982), The Schumpeterian trade-off revisited, *American Economic Review*, 72(1), 114–132
9. Hannan, M. and Freeman, J. (1977), The population ecology of organizations, *American Journal of Sociology*, 82, 929–964
10. Hannan, M.T. and Freeman, J. (1984), Structural inertia and organizational change, *American Sociological Review*, 49(2), 149–164

Interorganizational Systems and Supply Chain Management Support: An Analysis of the Effects of the Interorganizational Relationship

F. Pigni[1] **and A. Ravarini**[2]

Abstract This paper explores the influences that the interorganizational relationship has on the use of ICT characteristics in the supply chain context. In particular it analyzes the emergent patterns of SCMS use considering the underlying supported business process. The performed case study confirms the positive link between relational specific attributes and the ICT characteristics in a supply chain. Further evidences suggest that the interplay of scope and aims of IOS partners and limited ICT characteristics are at the base the mis-alignment between the possible and effective patterns of use of a SCMS.

ICT Support to Interorganizational Relationships

The study of interorganizational relationships received contributions from multiple disciplines [15] and the heterogeneity of contexts and times in which these where published are reflected in the proposed arguments adopting different models and underlying theories [6, 12]. Kern and Willcocks [7, 14] in their study of IT outsourcing relationships, performed an extensive survey of existing relationship approaches reporting that IS literature was still inconclusive and that a further investigation in organization and marketing ones was needed. However, despite the success of later contributions [8, 11, 13, 16], they were unable to conceive an integrative view, each addressing different aspects of the inherit complexity of an IO relationship. Consequently, the assessment of ICT effects on interorganizational relationships is a very active field, thanks to the plethora of theoretical references adopted for their analysis.

This paper provides an exploratory case study on the role played by existing relationships on the usage patterns of Supply Chain Management Systems (SCMS), "a particular form of IOS" [13]. The research framework draws its basis from

[1]France Télécom R&D Division, Sophia Antipolis, France, fpigni@liuc.it
[2]LIUC Università Carlo Cattaneo – Castellanza, Varese, Italy, aravarini@liuc.it

Subramani's and Chae's et al. previous works and is applied in the context of the videogame distribution supply chain in Italy. The study focuses on three main stages of the whole chain – publisher, distributor and retailers – and assesses the relationships and the SCMS uses from the distributor perspective. As already observed by Chae et al. [4], despite its relevant role, ICT alone does not fully explain interfirm collaboration. The availability of the technological infrastructure facilitates and supports the collaboration effort, and in some cases seems to effectively enable it. Nevertheless, the relationship at the base of the collaboration activities appears to affects how the infrastructure is employed.

Our first research question descend from these premises: *does the assessment of the interorganizational relationship provide a useful insight on emergent IOS use, as suggested in literature*?

Supply Chain Management Systems

SCMS are instances of IOS [13], in the sense that are those particular interorganizational systems in place among buyer and sellers, supporting typical supply chains process and activities. Organizations have recognized that SCMS, with their capacity to generate information flows across supply chains partners, have a key role in supporting Supply Chain Management (SCM) [2, 3, 5, 10]. Companies can develop close partnerships with other supply chain actors in form of shared information streams to forecast, produce, assemble, and just-in-time to ship their products. However, and instancing the previously stated research question, it is not clear the influence that existing relationships among partners may have on the use of SCMS, and how the availability of new technologies is reflected in their effective usage.

The next paragraph details the research framework and the methodology adopted to investigate the moderating role of IO relationship on SCMS use.[1]

Research Framework and Methodology

The research framework is depicted in Fig. 1. On the base of both Chae et al. [4] and Subramani (2004) works, we suggest this conceptual model exploring the effects of the interorganizational relationship on interorganizational collaboration examining in particular the effects on SCMS use. It is assumed, as reflected by the literature review, that the use of ICT among partners in a supply chain has effects on collaboration by enabling and shaping it. Adopting Chae's et al. [4] conceptual model, the study of ICT alone is argued to be insufficient to infer on interorganizational collaboration and that a similar understanding can be provided by characterizing the existing interorganizational relationship – i.e., on four dimensions such as: trust, interdependence, long-term orientation/commitment, and information sharing. The same

[1] The complete literature review on IOIS and SCMS is available upon request to the authors.

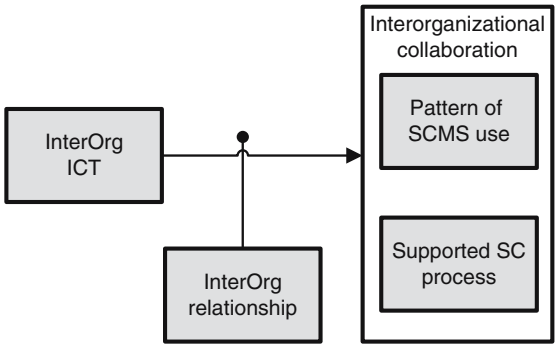


Fig. 1 The conceptual model based on Chae's et al. and Subramani's works

study demonstrates that the development of an IOS is the result of a socio-technical interaction and thus partners' formative contexts affect collaboration. We further explore this evidence arguing that the emergent properties of the interplay of ICT and interorganizational relationship are reflected in the different patterns of SCMS use – for Exploration and Exploitation [9, 13] – and consequently in the support of SC process – broadly categorized in execution and collaboration processes [1].

Case Setting

Leader Spa was founded in 1984 as a company specialized in the release, localization and distribution of PC and console software. From the beginning, the quality of the service towards customers and the relationship with publishers, have been key points of success. Leader's partners are famous international publishers like Eidos Interactive, Activision Italia, Microsoft Manufacturing, Electronic Arts Italia or Sega Europen. Leader's relationship with publishers has strengthened over time, surmounting technological and market evolutions, allowing Leader to reach almost 50% of the market share for PC software in Italy. Leader has devoted a lot of energy to the development of the Internet as a tool capable of offering services to their partners of high added value through the business portal www.leaderspa.it enabling the access to all the information available in company's information system (e.g., information on the product specification sheet of all available games, the reviews of specialized press, the available stock, the back order, the receipts emitted, the customer's account balance, the shipment tracking, the revenue, the products in store per individual publisher). Leader has more than 50 suppliers – the software publishers – and a large number of heterogeneous customers – from large retailers to small shops. Leader's main suppliers and customers were selected for the study as they represent the ideal targets of advanced collaborative efforts and are of great interest for the company as larger publishers tend to directly deal with large retailers de facto disintermediating Leader. The analyzed relationships involved then suppliers of the calibre of Microsoft Interactive, Sony Computer Entertainment, Electronic

Arts Italia, Activision Italia, Eidos Interactive, Sega European Limited, Midway Games, Empire Interactive Europe, Editorial Planeta De Agostini, FX Interactive and large retailers as Auchan, Carrefour, CDC, Coop, Db Line, EB Italy, Finiper, Fnac, and Mediaworld.

The Interorganizational Relationship

Collaboration. The degree of collaboration was based, according to Chae's et al. [4] study, both on staff evaluation and through specific examples of collaborative activities (problem solving, promotion campaign, display design, joint planning, forecasting, VMI and category management). Problem solving and promotion are considered "primitive" collaboration whereas VMI and category management are seen as "extensive". The collaboration with partners resulted to be generally medium/low testifying the lack of available and consolidated procedures for an effective coordination both with customers and suppliers. At the time of the study none of the companies was involved in extensive collaboration activities, and display design, joint planning and forecasting were the most advanced and performed activities. Only with DBline an auto-replenish system of the main products was put into place. Differently, Leader's staff ratings were mainly based on the level of involvement the company has respectively at the launch of a title with publishers and in the planning, assortment and stocking of products with customers. Based on the interviews it was then possible to identify in Sega, Midway, Empire, De Agostini, and FX, close partners publishers and in CDC, Db Line, EB Italy, Fnac and Mediaworld the close customers: in other words collaboration is greater with consumer electronic retailers. Furthermore it was possibly to observe a sort of negative correlation between the market relevance of a publisher and the collaboration with Leader, probably justified by the fact that larger players tend to directly manage large part of promotion, forecasting and planning and tend to rely on distributors to cover parts of the market as the great number of the small point of sales.

Interdependence. Interdependence was rated considering [4], for publishers, the relevance of sales generated on the Italian market by Leader and the percentage of turnover they generate for Leader, for customers on the significance of their sales,. Additionally, it was evaluated the level of business dependence between publisher-distributor and distributor-retailer. The general interdependence level is high for publisher and medium/high for customers reflecting the turnover composition where small points of sale contribute to around the 50% of total sales. Leader's staff rated large publisher like EA and Activision with only an average interdependence level as despite their relevance in terms of generated revenues, could approach the market through alternative channels. In particular, and Microsoft (long standing partner), is one of the most important publishers on the market and despite low level of collaboration, as previously defined, presents a relationship with an high degree of interdependence: Leader needs Microsoft's supply because their products constitute a large portion of the market, and, at the same time, Microsoft needs Leader to distribute

their products towards small and medium size points of sale. Sony is in a similar position, but it has just only recently started distributing through Leader and thus the interdependence is still low.

Long-term orientation. This dimension was evaluated on the base of top management orientation/commitment and the amount of investments on the relationship [4]. Because of the relevance that the analyzed partners have for Leader, company's commitment to long-term collaboration is always very strong and top management is always seeking new ways to offer and improve its services to both publishers and customers. In this sense, VMI solutions have been under study for years, but have not been implemented, yet. Either wise, larger general retailers like Finiper or Carrefour are actually moving toward a direct interaction with larger publishers thus hampering long term orientation. Leader's commitment to Sony is very high, however as the relationship has just started, the investment of both parties is still limited.

Trust. The evaluation of trust was based on interviews ratings regarding partners' benevolence and credibility [4]. Leader's trust in publishers is generally medium and medium/high as for the most part trust is always built, as the company states, "on paper contracts". However, only rarely contracts terms were breached or partially fulfilled. Leader poses the highest degree of trust in Microsoft, Sony and FX accepting the risks on the whole stock of products distributed. Similarly, problems with customers have rarely arisen (retards on payments and minor issues on contract terms), and mainly with general retailers.

Information sharing. This rating was determined on the base of the information shard between Leader and its partners [4]. Information sharing on order management is dealt through account managers or directly by the top management (FX and DB Line) dealing with partners and through agents with retailers, only once a distribution agreement is reached. With FX, in particular, top managements meets frequently to ensure the sharing of vision on promotional campaigns, inventory and payment information, implying a strategic dimension of the collaboration. Information exchange is further supported by realtime information trough reciprocal access to intranets data. Differently, retailers could provide additional market data exchanging information on sales and competing products figures in face to face representatives' visits (Mediaworld and Fnac). However, some large retailers' point of sales are not centralized managed and information are exchanged directly at POS level (Coop and Carrefour).

ICT characteristics. All partners have access to Leader's website to manage their accounts, however only FX effectively accesses all extranet data. Larger publishers (EA and Sony) exchange information on orders, administration and control other than via the web site, through the direct XML data exchange for order release. Exclusively for Microsoft, Leader has interfaced its system with their MSOps. Some customers are starting to adopt XML, whereas some major retailers are still using EDI based systems (Finiper and Carrefour). DB Line is an exception providing to Leader the access to their Stock Management System. Agents visiting retailers directly collects orders electronically and can immediately write them into Leader's IS: in normal conditions, an order can be processed and made ready for the delivery

in around fifteen minutes. An expected strong difference is observed between publishers and retailers ICT support as publishers are obviously mastering ICT whereas retailers are lagging behind lacking of interoperable – the majority of them do not provide access to theirs systems – and centralized systems (Carrefour and Coop). DB Line constitutes an interesting exception as it agreed with Leader on the automatic replenishment of some products on the base of the data available through their Stocks Management System.

ICT Effects on Collaboration and the Emergent Patterns of SCMS Use

The research model proposed to study the influence on collaboration of ICT and to analyze the emergent use of the available systems. The joint analysis of ICT characteristics and the strength of the relationship showed, to a certain extent, a positive link. This results confirms Chae's el al. [4] findings that the existing relationship can impact significantly on ICT use in supply chain. Low levels of information shared, trust or interdependence resulted in low ICT exploitation in supporting the interorganizational relationship (Coop and Finiper), and, at the same time, strong relationships were generally associated with an advanced ICT use (Microsoft, FX, DB Line). However, this conclusion seems to find two limiting factors. On one hand, publishers shows high ICT characteristics and obviously posses strong competences to support the relationship, but it was observed that in terms of SCMS the actual systems tend to support only SC Execution processes, whereas collaboration ones are limited to monitor and control. This typical exploitation behavior contrasts with Leader's willingness to scale the SCMS, showed by the total openness of their systems toward more collaborative uses. A possible explanation may imply that SCMS use for exploration and exploitation is limited by the interplay of scopes or the aims of partners, more than from the capabilities of the collaborative platform. Thus, ICT may stabilize cooperative behaviours, but "not necessary increase the level of interorganizational collaboration per se" [4] and, as showed by this study, the use of features available in the system.

On the other hand, low ICT characteristics of one of the party could greatly limit the use of advanced features of a SCMS despite strong relationships even if available or of interest and thus hindering the emerging relationship of collaboration, as the retailers' analysis has demonstrated.

Conclusions

This paper confirmed the earlier conclusion of Chae's et al. [4] suggesting that relational specific attributes can explain the ICT characteristics in a supply chain. In fact, a positive link between these two aspects was observed in the proposed case study.

However, both the interplay of scopes and aims of partners and the deficiencies of ICT characteristics constituted important limiting factors to the empowerment of the collaboration efforts. The emergent pattern of SCMS use resulted oriented toward the exploitation of the system, thus presenting a sort of interorganizational mis-alignment between the possible and effective uses of the SCMS on the base of ICT characteristics and existing relationship.

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References

1. AIP (2004). Il B2B in Italia: Finalmente parlano i dati – III Report of the Osservatorio B2B -/B2B in Italy: finally the data speaks – III Report of the B2B Observatory, Politecnico di Mi-lano, Milano
2. Balsmeier, P.W. and Voisin, W.J. (1996). Supply chain management: A time-based strategy. *Industrial Management*, 5, 24–27
3. Carter, J.R., Ferrin, B.G., and Carter, C.R. (1995). The effect of less-than-truckload rates on the purchase order lot size decision. *Transporting Journal*, 3, 35–44
4. Chae, B., Yan, H.R., and Sheu, C. (2005). Information technology and supply chain collaboration: Moderating effects of existing relationships between partners. *IEEE Transaction on Engineering Management*, 52(4), 440–448
5. Christopher, M. (1998). *Logistics and Supply Chain Management: Strategies for Reducing Cost and Improving Service*, Second Edition, Prentice-Hall, London
6. Haugland, S.A. (1999). Factors influencing the duration of international buyer-seller relationships. *Journal of Business Research*, 46(3), 273–280
7. Kern, T. and Willcocks, L. (2000). Exploring information technology outsourcing relationships: theory and practice. *Strategic Information Systems*, 9(4), 321–350
8. Malhotra, A., Gosain, S., and El Sawy, O.A. (2005). Absorptive capacity configurations in supply chains: Gearing for partner- enabled market knowledge creation. *MIS Quarterly*, 29(1), 147–187
9. March, J.G. (1991). Exploration and exploitation in organizational learning. *Organization Science*, 2(1), 71–87
10. Mukhopadhyay, T., Kekre, S., and Kalathur, S. (1995). Business value of information technology: A study of electronic data interchange. *MIS Quarterly*, 19(2), 137–156
11. Pavlou, P.A. (2002). IT-enabled competitive advantage: The strategic role of IT on dynamic capabilities in collaborative product development partnerships. Dissertation summary, University of Southern California, California
12. Ritter, T. and Gemünden, H.G. (2003). Interorganizational relationships and networks: An overview. *Journal of Business Research*, 56(9), 691–697
13. Subramani, M.R. (2004). How do suppliers benefit from information technology use in supply chain relationships? *MIS Quarterly*, 28(1), 45–73
14. Willcocks, L. and Kern, T. (1998). IT outsourcing as strategic partnering: The case of the UK inland revenue. *European Journal of Information Systems*, 7, 29–45
15. Yamada, K. (2003). Interorganizational relationships, strategic alliances, and networks: The role of communication systems and information technologies. In G. Gingrich (Ed.), *Managing IT in Government, Business & Communities* (pp. 216–245). IRM Press, Hershey
16. Zaheer, A. and Bell, G.G. (2005). Benefiting from network position: Firm capabilities, structural holes, and performance. *Strategic Management Journal*, 26, 809–825

Reconfiguring the Fashion Business: The "YOOX" Virtual Boutique Case Study

A. Resca and A. D'Atri

Abstract The premise of this work is based on a belief that information technology is an important driving force not only for following new business strategies but also for contributing to the reorganization of entire business sectors. Normann's work "Reframing Business" which has been taken as a point of reference for investigating the factors which enable these phenomena and "Yoox" virtual boutique forms the case study which is examined in this perspective. The concept of prime mover, in some sense, represents this perspective. A prime mover exploits market imperfections, takes advantage of technological breakthroughs and, above all, reconfigure a new business model mobilizing new competences, overcoming business borders and re-shuffling actors' roles. Yoox can be considered a prime mover. Selling activity has been completely reconfigured. Undeniably, shops with their walls vanish in favor of a virtual website and local customers typical of traditional shops have been substituted by global internet web surfers. Moreover, Yoox is emerging as a provider of e-commerce platforms providing a key in hand online selling system to fashion brands and in this way the rules of the game of the fashion sector, has been, albeit marginally, modified.

Introduction

Yoox, a virtual boutique is a case study which seeks to investigate those factors that have enabled the emergence of innovative actors in such mature economic sectors as fashion. Yoox, the focus of this case study, is a virtual boutique for fashion and design multi-brands. This means that, selling on-line fashion items, space constraints (traditional shops) and time constraints (opening hours) have been overcome. Moreover, it is possible to access and purchase Yoox's products wherever and whenever the demand arises. This enables the fashion seasons to be prolonged which improves

Università LUISS – Guido Carli, CeRSI – Centro di Ricerca sui Sistemi Informativi, Roma, Italy, aresca@luiss.it, datri@luiss.it

the management of leftover stock. These are just few of the examples in this proposal.

Normann's work [1] is the point of reference with which to examine these innovative factors. In particular, it suggests that, historically, three strategic business paradigms have been dominant: industrialism, customer base management, and the reconfiguration of value-creating systems. The first paradigm stresses the role of production whereas the market is considered to be its passive destination. The 1970s saw the emergence of the second paradigm which focuses on customers and the ability of businesses to establish relationships with them. Customer loyalty programs relate to this perspective, for example. The late development of information technology is seen as a driving force towards the third paradigm. Here, businesses are not only considered as competent actors, producing or establishing relationships with customers but are also seen as value makers. That is, entities, even virtual ones, that consider customers and providers as actors whose relationship is characterised by one of co-production and co-design. The objective, here, it is not only to satisfy a customer but also customers of the latter, for example. This involves a reorganization of business borders and establishing of relationships that are able to reconfigure an entire business sector.

We can presume that the reconfiguration of a value-creating systems paradigm is an instrument for investigating a virtual boutique such as Yoox which can be considered an innovative actor in the fashion business international survey.

From Value Chain to Value Constellation

The concept of a value chain as an instrument to identify the potential competitive advantage of a company is suggested by Porter [2]. This instrument involves a subdivision of business activities and their role of determining added value. In this way, companies can acquire knowledge regarding the strengths and weaknesses of their businesses and adapt the best strategy accordingly. In the 1990s the attention moved away from the value chain towards core assets and competences leading to the resource based strategy [3, 4]. In the same period, Normann and Ramirez [5] introduced the concept of value constellation which is considered to be an evolution of the value chain concept. The view suggested by the latter is an economy in which 'Fordism' and 'Taylorism' still play an important role and where the transformation of inputs into outputs are represented straightforwardly. Now, the possibility to produce value for customers is more varied and the constellation of a value metaphor seems more appropriate.

This is due, mainly, to technological innovations and in particular the information technology and the internet. They have overcome many of the constraints that have impacted our working lives in terms of such criteria as: time, place, actor and constellation [1]. For example, when and where activities can be done, who does these activities and with whom they can be done. In this way, the chain is disentangled leading to a reorganization of economic activities according to a large range of

solutions. At the basis of this phenomenon there is the dematerialization process that consists of the separation between information and the physical world. For example, the same content can be transmitted by email and by normal mail but the latter requires a more intense involvement of the physical world. The dematerialization process deals with obstacles when the repository of information or knowledge is a person. Tacit knowledge [6] has this characteristic as well as knowledge developed in a specific socio-cultural context. Nevertheless, technological innovation and, in particular, information technology contributes significantly to the development of this dematerialization process which considerably affects all factors of productions. Exchanges are favoured due to the reduction of transaction costs [7], economies of scale are common in consequence of low reproduction costs of immaterial assets [8], at the same time economies of scope are promoted in consequence of the flexible combination of these factors. Furthermore, the labour market is continuously opening its doors, and financial capital markets are already commonplace all over the world etc.

In this context or in this value space, three main protagonists can be singled out [1]: imperfection-based invaders, technology path-breakers and prime movers. In the first case, actors exploit markets subjected to deregulation policies as new business strategies become available or niche markers where market forces do not operate properly. Technology path-breakers are those actors who take advantage of technological innovations to achieve a competitive advantage. Finally, prime movers require further elaboration. A prime mover not only exploits market imperfections, or takes advantage of technological breakthroughs but, reconfigures a new business model, the results of which form the dematerialization process. The work of a prime mover is detectable by a design vision that leads to a broader system of value creation. External actors and new competences are mobilized, old business borders are overcome and actors' roles are re-shuffled. If this reconfiguration process puts into operation by a prime mover does not involve products or services but a whole business system, the term ecogenesis comes to the fore [1]. In this case the rules of the game have been re-shaped leading to infrastructure and business ideas that influence strategies, actions and networks of other actors operating in the system. The following section takes into account Yoox's business model, which forms a further step in the analysis of this case study.

Yoox: A Virtual Boutique for Multi-Brand Fashion and Design

Yoox was established during the so called new economy in 2000, and shared many characteristics of the start ups of that period. Yoox is a typical Dot-com company in which venture capital firms played and are still playing an important role today even though its management continues to be in the founder's hands. Yoox sells fashion products on-line from its headquarters in Italy and has a branch in the US and in Japan. According to the Yoox website (www.yoox.com), this company is currently considered to be the number one virtual boutique for multi-brand fashion & design

in the world, primarily due to the 1 million products delivered during 2006, and the 3 million website hits each month. The company has experienced considerable growth; launching its presence in the European Union in 2000. This was followed by product launches in Canada and the US in 2003, Japan in 2005 and 25 other countries throughout the world in 2006. Turnover amounted to 4 million euros in 2001 and 49 million in 2006.

As has already been alluded, Yoox can be defined as a virtual boutique for multi-brand fashion and design, however, further elaboration is required. Indeed, a significant part of the business is due to the selling of a selected range of end-of-season clothing and accessories at accessible prices from such global brands as Armani, Gucci and Prada, to name but a few. Nevertheless, particular attention is dedicated to small brands unheard of on the international scene, as opposed to those ones which are readily available in department stores. In this way, Yoox opens the international market up to include niche labels which have smaller distribution channels.

Even though the selling of end-of-season clothing and accessories constitutes and will continue to constitute Yoox's main business [9], a differentiation strategy has always been pursued. Such a strategy includes exclusive collections for YOOX by prestigious Italian and international designers, vintage collectibles, the launch of collections by new designers, a selection of design objects, and rare books. In such instances a discount policy was not adopted, instead a full-price one was favoured. All of these factors contribute to determining one of the main objectives of this Dot-Com company, that is, to build a virtual environment for experiencing the evolution of fashion, rather than a simple website for buying discounted items.

In order to detail the activities run by Yoox, items are purchased or charged to the company with the formula of "payment upon sale" by fashion houses, manufacturers, licensees and boutiques, and are stored in Italian warehouses where they are classified and photographed in order to be put on the website. A digit code is assigned to each item enabling tracking during the selling process and other important retail information such as size and colour to be tracked. At this point, the item can be identified through radio-frequency technology for the selection and packaging of stock. This platform was designed internally, however by 2000 market technology was neither responding to the needs of the company, nor was considered sufficiently reliable. These activities were eventually outsourced: the selection and packaging of stock was outsourced to Norbert Dentressangle and the delivery to UPS. In Yoox's business UPS's role is important. On the one hand, it is responsible for the sorting of goods between the Italian centre and hubs in the US and Japan. On the other hand, it guarantees time definite delivery or scheduled delivery to customers. Moreover, in the case of a purchase return, this often occurs due to the nature of the items marketed, UPS picks up returned goods free of charge.

So far, in this analysis, the selling process has been taken into consideration. Now the attention turns to the purchasing process by customers. It is not easy to orientate oneself amongst the 100,000, and sometimes more, items promoted by Yoox. In such promotional displays, items are subdivided according to the seasons

(autumn–winter collections, and spring–summer collections) and sex (male and female). At such points of reference, Yoox's website proposes two main search solutions: designers and categories. That is, items can be searched according to the designer or category (footwear, denim, coats and jackets etc.). At the same time, a research engine is available in which searched for items can be described in detail. In this way, the bulk of end-of-season clothing and accessories can be surfed, whereas another part of the home page is dedicated, for example, to categories such as "new arrivals", "sale items", a specific fashion style or a particular fashion category. Product searches are aided by a series of instruments. Surfed items are tracked and promptly available for improving the selection process, and web surfers can take advantage of the so called "Myoox". "Myoox" is a personal home page accessible by a user ID and password where it is possible to indicate the desired items, items selected but not purchased and an account takes note of previous purchases. Each item is displayed, and front and back and zooming enables purchasers to view items from different perspective in order to be informed as much as possible about the items in question. A basket regroups selected items and two kinds of shipment are available: standard and express. Payment can take place by credit card, PayPal or by cash on delivery (in this case a small fee is charged). If purchased items do not fit the customer's tastes it is possible to return items free of charge, and the total amount is reimbursed to customers within 30 days upon receipt of goods.

We now need to turn our attention towards the marketing strategies adopted by Yoox. In other words, in which ways can potential customers be made aware of the Yoox website? It is obvious that the diffusion of the internet is fundamental and broadband internet access would certainly favour the surfing of pictures and other procedures typical of Yoox. However, this is only the first step in a range of interventions. At present, Yoox follows the policy of dedicating a specific website for different geographies, as the tastes, habits, needs and market conditions vary by country. In particular, the point is to build a specific company profile to capture the main local fashion trends. Indeed, 17 countries worldwide representing, presumably, less important markets, share the same website. Language is another problem. Italian, French, German, Spanish and Japanese websites are now in their respective languages whereas the remainder are in English. Nevertheless, two main strategies are followed for the promotion and marketing of the Yoox website. The first one consists of an affiliate programme. In other words, anyone who has a website can give hospitality to Yoox's links and receive a commission from 5 to 12% on sales according to the amount of revenues generated by referred visitors per month and by country. At present, there are about 90 websites which collaborate with Yoox in this way. The second one concerns policies towards Google and other search engines. In particular, investments are focused on the number of clicks on niche labels rather then big brands in order to target sophisticated customers looking for particular fashion trends. At the same time, the Yoox banner is present in on-line versions of important fashion magazines, and collaborations have been established with museums, beaux arts academies, art exhibitions, fashion institutes, and cinema etc., in order to promote Yoox's image as a research centre of fashion and expertise.

Yoox: A Reconfiguration of Value

The point, now, is to interpret the Yoox's case study according to the theoretical approach introduced in section "Yoox: A Virtual Boutique for Multi-Brand Fashion and Design". Can concepts such as value constellation, the dematerialization process, imperfection-based invader, and prime mover etc. actually represent the position played by Yoox's role in the fashion sector?

Firstly, let's see if a dematerialization process has taken place and, in particular, towards the customer. The internet enables the overcoming of time and space constraints. In fact, 24 h a day and in more than 50 countries around the world Yoox's items are available. Moreover, shop assistants have disappeared and have been replaced by a website. This is the main issue to manage: to create a virtual environment that enables online purchases. In this proposal, customers are supported by a green number and a customer community. The dematerialization process has influenced providers as well. They can easily control the price of items for sale by Yoox and, in this way, avoid the excessively low prices during end-of-season sales that damage a brands' public image. At the same time, Yoox utilises another channel of distribution that reaches more than 50 countries and enables end-of-season sales 365 days a year. The supply chain and deliveries have been subject to a dematerialization process as well, due to both the pervasive role of information technology and the externalisation of these services to third parties.

The question now is: is Yoox an imperfection-based invader, a technology path-breaker, or a prime mover? It is an imperfection-based invader owing to its capacity to carve out a niche market selling end-of-season fashion products online. However, it is a technology path-breaker as well. Breakthrough technologies have been introduced both on its website and in its warehouse management systems. Nevertheless, Yoox can be considered a prime mover. Selling activity has been completely reconfigured. Undeniably, shops with their walls vanish in favour of a virtual website and local customers typical of traditional shops have been substituted by global internet web surfers.

Finally, the focus now is to see if Yoox has been the protagonist of a so-called ecogenesis. Namely, if the fashion sector has in fact been reorganized, and new game rules are indeed governing it. Surely, Yoox's role in this sector is marginal in comparison with department store chains and global brands. Nevertheless, it is a protagonist in the online shopping phenomenon and is emerging as a provider of e-commerce platforms. In fact, in 2006, Yoox Services unit was founded. Its objective is to provide a key in hand online selling system to fashion brands. In 2006, Marni and, in 2007, Armani took advantage of Yoox's logistic and front-end platform in order to directly sell full-price products online. This represents a significant turnaround for leading fashion houses such as Armani. At first, Armani was a Yoox's provider but now it is also a customer. In some sense, the rules of the game of the fashion sector, has been, albeit marginally, modified. Yoox could in fact play a diverse role as it is no longer confined to being a virtual boutique for multi-brand fashion and design, its role has been redefined and broadened to provide a key in hand online selling system for high-end fashion items.

Conclusion

This case study throws light on the fact that taking advantage of technological innovation through related business strategies leads to good business opportunities. Services and products can be deeply reconfigured and even entire business sectors can be subject to significant reorganization. At the same time, at the basis of these processes there are important organizational, technological, and financial constraints. In this proposal, in light of the new economy crisis at the beginning of this decade, and the failure of similar ventures, we need to think about the possibility of re-launching a business plan similar in character to the Yoox model. In this way, the perspective moves to the characteristics of the business environment. In other words, what emerges from the Yoox case study, is the sheer complexity to develop similar start-ups, especially if the external environment does not collaborate to support these kinds of ventures, such factors as the financial system, the research and development level, a well trained workforce, and a sound institutional environment. All of these factors creates a new perspective that requires further investigation.

References

1. Normann, R. (2001). *Reframing Business. When the Map Changes the Landscape*. Wiley, Chichester
2. Porter, M.E. (1980). *Competitive Strategy: Techniques for Analyzing Industries and Competitors*. The Free Press, New York
3. Grant, R.M. (1992). *Contemporary Strategy Analysis: Concepts, Techniques, Applications*. Basil Blackwell, Cambridge
4. Prahalad, C.K. and Hamel, G. (1990). The core competence of the corporation. *Harvard Business Review*, 68, 79–91
5. Normann, R. and Ramirez, R. (1993). From value chain to value constellation: Designing interactive strategy. *Harvard Business Review*. 71(4), 65–77
6. Polanyi, M. (1969). *Knowing and Being*. Routledge & Kegan, London
7. Ciborra, C. (1993). *Teams, Markets and Systems*. Cambridge University Press, Cambridge
8. Shapiro, C. and Varian, H.R. (1998). *Information Rules: A Strategic Guide the Network Economy*. Harvard Business School Press, Boston
9. Tate, P. (2006). Yoox and Me www.benchmark.com/news/europe/2006/11_18_2006.php. CITED 28 AUGUST 2007

Organisation Processes Monitoring: Business Intelligence Systems Role

C. Rossignoli[1] **and A. Ferrari**[2]

Abstract The purpose of this paper is to analyze if Business Intelligence Systems (BISs) can facilitate the monitoring of the uncertainty inherent in the organisation processes and consequently contribute to achieve its performance objectives.

Introduction

Organisations are open social systems that face uncertainty when making decisions [1] regarding company processes. Facing this uncertainty it must facilitate the collection, gathering and processing information about all organisational variables [2] BISs concern technologies supporting the Business Intelligence (BI) process, an analytical process which allows to gather and transform data into information [3–5]. Company processes are studied in the literature as a group of information processing activities. An approach of this kind, adopted for the purpose of this paper, is the Information Processing View (IPV), according to which organisations may reach a desired level of performance if they are able to process information to reduce the uncertainty characterizing their processes [6, 7].

The research method adopted in this paper is the study of a selected case, i.e., an international company in the pharmaceutical sector. It concerns the implementation of a Business Intelligence System (BIS) to monitor the overall production activities of the plant in order to guarantee the efficiency of the manufacturing process so as to improve performance. Based on the initial results of the analysis, BISs really contribute to an enhanced control the manufacturing process, and consequently improve the management of uncertainties generated by incomplete information flows and occurrence of random events. Prompt monitoring of uncertain conditions allows to take the corrective actions that contribute to achieve the desired level of performance.

[1]Universita di Verona, Verona, Italy, cecilia.rossignoli@univr.it
[2]Università LUISS – Guido Carli, Roma, Italy, antonella.ferrari@economia.univr.it

Environmental Uncertainty and Internal Environment

The subject of uncertainty in organisational studies is mainly considered in terms of environmental uncertainty (influence of external environment) and related impact on the sector, i.e., the actions of competitors and the choices of consumers [8]. A high environmental uncertainty causes a greater complexity and increases the number of elements to take into account when investigating the internal environment [9]. Managing uncertainty means to provide company decision-makers with data, information and knowledge useful to assess the environmental factors that produce such uncertainty and that influence in a hardly predictable way changes in the external environment. Many authors have carried out studies on environmental uncertainty and its ramifications in the strategy, structure and performance of a company [10, 11]. Still following a contingent approach, Burns and Stalker contributed to the issue of uncertainty control differentiating between organic and mechanical management processes. The results of their studies showed the existence of a correlation between external environment and internal management structure: as the uncertainty in the external environment increases, companies tend to transform mechanical management processes into organic processes, in order to adapt to the changes required by the context where the organisation operates [12].

Therefore, considering the key variables necessary to manage uncertainty, this paper provides an interpretation model – based on a real case – that can be used to map the uncertainty caused by external factors and influencing internal performance. An improvement of performance that can be achieved through the company processes control and the use of proper information technologies. The interpretation model is applied to the production process, where the complexity of the activities to be monitored and the influence exerted by the variability and unpredictability of such activities are considered crucial.

A Few Notes on the Concepts of Company Process, Production Process, Performance and Information Technologies

Company process means a systematic series of activities that, even if they are of a different kind, aim at reaching the same objective. Activities involve human resources, production factors and "the technologies" to carry them out. Moreover, they use and create information. A process is defined as "core process" when it is made of the primary activities of a company and has a direct relation with the external customers (for example, production) and it has a direct impact on company performance [13]. A company production process is a core process concerning the whole of activities meant for the material transformation of goods. Three production macrophases can be outlined: procurement of raw materials, production and distribution [14]. The performance associated with the production process can be measured in terms of cost, quality, time and flexibility [15, 16]. Cost performance includes productivity and efficiency, that is the output/input relation. As for quality, the concept

of conformance should be especially considered, i.e., compliance with the specifications [17]. Time means prompt, on-time and reliable deliveries, while flexibility means the ability of a given variable (volume, production mix, etc.) to vary within certain cost, time and quality constraints [14]. The technologies associated with the production process can be classified in three categories: process technologies (i.e., the technologies necessary to carry out, at different automation levels, all phases of the transformation process, that is, transportation, handling, storage, production and distribution); product technologies, whose purpose is to increase quality and reduce costs; information technologies, for information gathering, processing and communication (information and computer systems). BISs can be included in this category.

The Control System of Production Processes and Business Intelligence Systems

Control is the regulation and governance of the behavior of a system in view of the pursuit of objectives defined in the presence of environmental constraints. A control system is defined, in a broad sense, as formal routines, reports and procedures that use information to keep or modify schemes of activities [18]. Some studies have shown that intense competition on products causes an increase in the use of highly analytical control systems [19]. The main purpose of a system controlling the production process is monitoring the following critical factors: "just-in-time" availability of raw materials, purity and quality of products, work flow quality, productivity and efficiency, allocation of production resources, compliance with tolerance levels, conformity, safety, product traceability, operating and maintenance costs, delivery time. Compliance with prefixed standards of each of these factors affects the performance of the process in terms cost, time, quality and flexibility. On a practical level, monitoring occurs due to the functions implemented in the control system, which can be summarized as follows: management of information flows, data processing, visualization of trends and indicators, support to operational decisions and management of corrective actions. The effectiveness of a control system can be assessed based on the features of the system associated with the above mentioned functions: complete and accurate data, data integration, relevance of data for decision-making, prompt information, data security and integrity (management of information flows and data processing); easy interactivity, immediate interpretation, information process acceleration, rapid learning (visualization of trends and indicators). Moreover the system is effective if it complies with requirements such as selectivity, flexibility, verifiability and acceptability by users.

Information uncertainty (the difference between the information needed to handle a given activity and the amount of information already available, according to the IPV approach) depends on the capability of processing and correctly interpreting information. Such capability can be emphasized with a control system having the above mentioned functions, which are typical of a BIS: information flow

management, data processing, visualization of trends and indicators supporting the production process operational decisions and the related corrective actions. Due to current technological advancements, a BIS, when adequately implemented, should satisfy the effectiveness requirements of a control system. If a BIS were really able to represent a control system that is effective in monitoring the various phases of a production process, one might contend that such system contributes to the management and subsequent reduction of uncertainty inherent in production activities, with positive implications in the performance of the process.

Case Study

Research Method

The research design includes the analysis of a case which is significant due to the following reasons: even though the company is based in Italy, it belongs to a major international corporation and cooperates, in terms of turnover, with customers distributed all over the world; BISs applied to the production process has been used for more than 3 years and therefore its use is engrained in the managerial culture of the company; complexity of the production process in the pharmaceutical industry and a stringent need to monitor situations characterized by highly uncertain environments; high relevance of BISs when making strategic and operational decisions. Qualitative data gathering tools, mainly based on interviews with strategic and operations managers, systems designers and administrators and users of the information systems were used.

The Janssen-Cilag Case, a Johnson & Johnson Company

The plant of Janssen-Cilag S.p.A. in Latina, Italy, which is one of the six plants for pharmaceutical production of the Johnson & Johnson group in Europe, represents the only production pole in the world able to meet the needs of all sectors in the pharmaceutical field. The plant produces and packages pharmaceutical specialties in solid (capsules and tablets) and liquid (solutions and shampoos) form, using active principles developed in the European research centers. Each year, more than 90 million finished product units are manufactured, 15% of which are distributed in Italy and 85% shipped abroad. The production process is based on an industrial automation mechanism consisting, in large part, of robotized operations (Flexible Manufacturing System – FMS). It comprises the following phases: raw materials are weighted and prepared according to the recipes of semi-finished products, active ingredients and excipients; blending, mixing and formulation of elements to obtain finished products (in different forms, such as, vials, capsules, bottles, injections, powders or pills); primary packaging; secondary packaging; storage; preparation for shipping.

The Business Intelligence System

The purpose of the BIS is enabling the monitoring of the entire manufacturing process. There are two main categories of the BIS users: staff assigned to production facilities and staff at the intermediate level responsible for activities concerning planning and allocation of resources – human and material – as well as customer assistance activities. The system is integrated with the information systems of the production line and receives and manages information flows regarding: allocation of raw materials for the purpose of guaranteeing "just-in-time" availability of the right quantities and right materials, and consequently reducing uncertainty, due to incorrect distributions, and accelerating distribution times; other logistics activities for weighing and preparation, for the purpose of using a flexible method for the allocation of production capabilities, and being also able to guarantee product traceability at all times; product quality, through constant monitoring of tolerance levels in process parameters, whose compliance is one of the fundamental requirements of all phases of a pharmaceutical production process, as well as detection of possible deviations; validation of plants to allow prompt intervention in case of failures or inefficiencies as well as adoption of preventive measures; management of the activities for packaging and shipping, which need special attention considering the different language requirements and numerous shipping procedures due to the high number of destination countries (almost 60). Distribution priorities are also handled in order to guarantee best service to end customers. The data contained in the various information flows are appropriately processed and the results of such processing operations are visualized, in a graphical form and as indicators, inside panels that can be accessed by the staff from their personal computers or 42-in. LCD screens situated in the production facilities, or directly from palmar devices.

Initial Results and Conclusions

Based on the initial findings of the analysis of the case, the BIS actually contributes to ease uncertainty throughout the various phases of the production process, which in turn has a positive effect on performance.

The BIS can be defined as a control system as it allows to monitor some critical factors: *just-in-time* availability of raw materials, products quality, work flow quality, productivity and efficiency, allocation of production resources, compliance with tolerance levels, conformity, safety, product traceability, operating and maintenance costs, delivery time. Its effectiveness is proven by its compliance with basic requirements: it guarantees data completeness and accuracy and related security, and integrity and integration. Moreover, it promptly provides information to decision-makers. The system can be considered: selective (data adapt to users and are actually useable for, and used by, them); flexible (it can rapidly adapt to new information needs and changing information production and distribution techniques); accepted by users (at the time of its implementation, users did not oppose or resist

its introduction). The good visualization techniques of processed information guarantee easy interaction, immediate interpretation and acceleration of the information process that contribute to the effectiveness of the system. Moreover, visibility of the activities of the production plant help the learning and the creation of a cooperative environment where knowledge is shared and exchanged and where each employee feels more responsible, motivated and involved in the achievement of company objectives. Following the implementation of the BIS, performance of the production process has improved: reduced costs thanks to increased productivity generated by increased production capabilities in terms of lower improper allocations of raw materials, better allocations of material resources, higher promptness in overall management and even prevention of breakdowns or inefficiencies. Increased product quality is also recorded, thanks to product traceability throughout the various processing phases along with a constant recording of tolerance levels in the various parameters, which improves reliability and awareness on product compliance with the required specifications, an essential feature for pharmaceutical products. Benefits are found in relation to the variables of time and flexibility, especially regarding delivery to customers. This cause a higher number of on-time deliveries, the ability to meet the diverse needs of customers scattered all over the world and consequently an increase in customer satisfaction for the type of service rendered.

The use of the BIS has a positive effect on the performance of the production process, and also positive implications at an organisational level: besides improved cooperation and knowledge exchange, the staff employed in the production department is more involved and therefore feels more able and responsible when making operational decisions. Perceiving the increased importance of its role, it therefore attributes more value to its contribution to the achievement of company objectives.

Based on the initial results of the analysis of the Janssen-Cilag case, it is fair to say that BISs can ease the operational mechanisms of an enterprise enabling continuous monitoring of the various activities and prompt intervention in case of uncertain situations. As a consequence, they contribute to generate positive effects in terms of compliance with preset standards and overall improvement.

However this analysis has some limitations and it is needed a further study, involving other organisational processes as well as other companies having processes control systems implemented by BISs.

References

1. Thompson, J. (1967). *Organisation in Action*. New York: Mc Graw-Hill
2. Zaltman, G., Duncan, R., and Holbek, J. (1973). *Innovation and Organisations*. New York: Wiley
3. Grothe, M. and Gentsch, P. (2000). *Business Intelligence. As Informationen Wettbewerbsvorteile gewinnen*. München: Addison-Wesley
4. Weber, J., Grothe, M., and Schäffer, U. (1999). *Business Intelligence. Advanced Controlling*. Band 13. Vallendar: WHU Koblenz, Lehrstuhl Controlling & Logistik
5. Davenport, T.H. and Prusak, L. (1998). *Working Knowledge: How Organisation Manage What They Know*. Boston: Harvard Business School Press

6. Galbraith, J. (1973). *Designing Complex Organisations*. MA: Addison-Wesley
7. Galbraith, J. (1977). *Organisational Design*. MA: Addison-Wesley
8. Hoskisson, R.E. and Busenitz, L.W. (2001) Market uncertainty and learning distance in corporate entrepreneurship entry mode choice. In M.A. Hitt, R.D. Ireland, S.M. Camp, and D.L. Sexton (Eds.), *Strategic Entrepreneurship: Creating a New Integrated Mindset* (pp. 151–172). Oxford: Blackwell
9. Fiol, C.M. and O'Connor, E.J. (2003). Waking up! Mindfulness in the face of bandwagons. *Academy of Management Review*, 28, 54–70
10. Dess, G.G. and Beard, D.W. (1984). Dimensions of organisational task environments. *Administrative Science Quarterly*, 29, 52–73
11. Tung, R.L. (1979). Dimensions of organisational environments: An exploratory study of their impact on organisational structure. *Academy of Management Journal*, 22, 672–693
12. Burns, T. and Stalker, G.M. (1961). *The Management of Innovation*. London: Tavistock
13. Earl, M. and Khan, B. (1994). How new is business redesign? *European Management Journal*, 3, 20–30
14. De Toni, A., Filippini, R., and Forza, C. (1992). Manufacturing strategic in global markets: An operation management model. *International Journal of Production Research*, 31(6)
15. Wheelwright, S.C. (1978). Reflecting corporate strategy in manufacturing decisions. *Business Horizons*, 21, 57–66 Febbraio
16. Hayes, R.H. and Schmenner, R.W. (1978). How should your organize manufacturing? *Harvard Business Review*, 56(1), 105–118
17. Juran, J.M. (1989). *Juran on Leadership for Quality*. New York: The Free Press
18. Simons, R. (1991). Strategic organisations and top management attention to control systems. *Strategic Management Journal*, 2, 49–62
19. Khandwalla, P.N. (1972). The effects of different types of competition on the use of management controls. *Journal of Accounting Research*, 10, 275–285

The Organizational Impact of CRM in Service Companies with a Highly Advance Technology Profile

R. Virtuani and S. Ferrari

Abstract The paper analyses the organizational implications of an advance CRM strategy adopted by customer-oriented service companies in the credit card issuing sector characterized by high investments in very advance technological infrastructure. The study is based on a multiple case analysis. The research model is focused on the evaluation of the organizational impacts of the achievement of CRM strategy objectives of personalization of service delivery without losing the economic advantages linked to the cost savings generated by large scale service productions. The results of the research show the wide organizational impacts produced searching the alignment among an advance CRM strategy, the most efficient and effective use of a very advance technology infrastructure and the organizational design choices concerning the division of labour, the customers contact operators' level of specialization and professionalism and the characteristics of some units of the organizational structure.

CRM in Service Companies

The challenge that service companies are facing since the last decade is creating customer-oriented systems [1–3]. The philosophy of management of a customer-oriented organization places at the centre of the strategy to obtain a sustainable competitive advantage the creation and the maintenance of continuative relations with the customer to maximize the value produced for both the customer and the company (Fig. 1). This implies the founding of the company's action on the mission of the satisfaction of customer's current and expected needs aiming the building of his loyalty along the time and the creating of relations based on trust. The achievement of company's strategic objectives of a customer-oriented organization is largely studied by the scholarly and popular marketing literature which identify

Università Cattolica del Sacro Cuore, Piacenza, Italia, roberta.virtuani@unicatt.it, stefano. ferrari@isbs.it

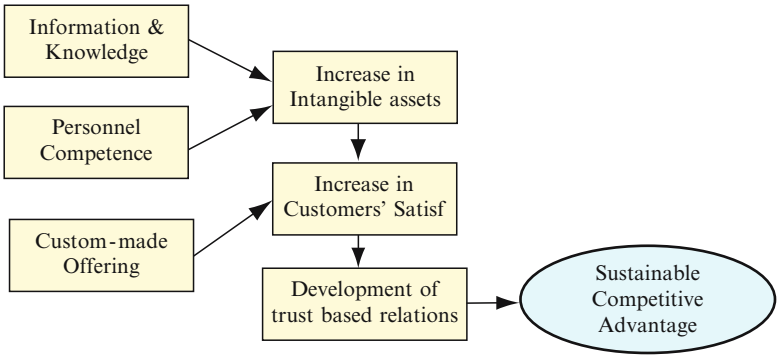


Fig. 1 Trust based relations to obtain a sustainable competitive advantage

the critical success factors or its realization in three main aspects: (1) the company's ability to generate information and knowledge on the present and potential customers, (2) the competence of the personnel who is in a face to face contact with the customer in the service delivering; (3) the organisational capacity to offer a custom-made service [4–7].

Customer Relationship Management Systems – CRM have been developed to reach the objectives of a customer-oriented organization through the development of long term trust based relations. One of the aspects that the wide literature on CRM have not deepen very much concerns the organizational implications of a custom-made offering by service companies. [3, 8] Even in the service sector enterprises are facing the phenomenon of the mass customization that in 1995 Milgrom and Roberts theorized for the industrial sector in their article "Complementarities and fit. Strategy, structure and organizational change in manufacturing". [9] To maintain to economic saving obtained through a large scale of production but at the same time satisfy the personal needs and tastes of single clients the massive introduction of information and communication technology in production systems allowed the implementation of flexible and integrated systems from the design phase with Computer Aided Design systems – CAD to Computer Aided Manufacturing systems – CAM to Enterprise Resource Planning – ERP. The aim of this contribute is to analyse and show the organizational change produced on organizational structure, organizational processes and on personnel's competences by mass customization in the service sector to enlighten the deep organizational impact and change produced by CRM systems on companies in which, traditionally, the manual work is prevailing [10].

The Method

Our research project is based on a multiple case analysis of two companies in the financial and banking sector. We interviewed two of the five main players in the credit cards sector in Italy. We will call them Player A and Player B. Player A is

owned by a Consortium of Italian Banks. Player B is a business unit belonging to a foreign banking group.

They have both renewed their technological systems in the last 3 years to better support their CRM strategy. Their technological systems architectures are very advanced considering the international scene as reference. In particular Player A took part to two international competitions where the CRM technology infrastructure was evaluated and won the first award in both cases.

Five persons were interviewed in each company. They were the general director, the marketing director for Player A and the CRM director for Player B, the organizational development director, the information systems director and the post selling director. The interview with each of them lasted nearly 70 min. Our main contact was the organizational development director for Player A and the CRM Director for Player B. They provided us with documents and reports we analysed before the interviews.

The Research Framework

The research framework we adopted aims to answer to three main questions:

- In customer-oriented companies with highly advanced CRM systems does the customer contact operators' need a higher level of professionalisms to deliver a custom-made service?
- In customer-oriented companies with highly advanced CRM systems are the customer contact operators specialized according to the customers' target from prospect, strategic, affluent, family and corporate types?
- Giving substantially equal CRM technological infrastructures does the design of the organizational structure impact on the production and use of the information concerning customers deriving from the service delivery activity?

The questions concern decisions related to organizational choices whose relevance impacts on the company's final strategic and economic results. The main objectives of a CRM strategy are the increase of the number of customers, the increment of the more profitable customers, the increase of the rate of retention and of the efficacy of the marketing actions. In order to obtain benefits through the cost reduction, other objectives relate to the speed up of the sale cycle, the shortening of the time of interactions with the customers, the cutting of the customer's contact operators' number and of the length of the time for their training. The aim of the CRM strategy is to find the most valuable balance between the level of personalization delivered to the client, as highest as possible, and the cost of its production, as lower as possible. The answer can be find through the efficient and efficacious mix of technological and organizational choices.

At a first sight we could think that:

- The delivering of a custom-made service requires an high professionalisms that can be obtained through an intense training and the hiring of high education profiles.

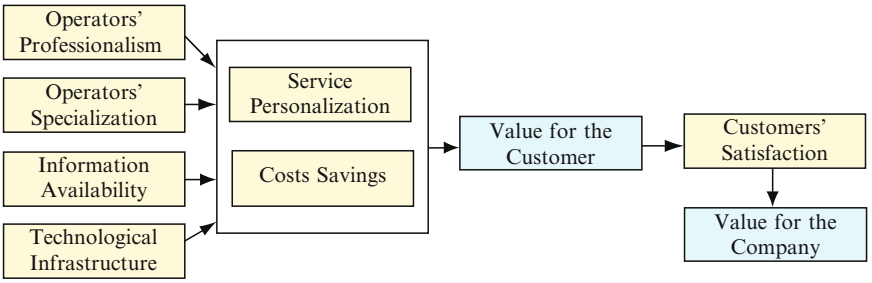


Fig. 2 The research model

- The customer's contact operators are specialized according to the customers' different target to better address the service offer to customers needs, preferences and expectations making different the service quality level. To a different operators' specialization level correspond a different operators' professionalisms, measured through the rising difficulty of the questions, requirements and problems the customers present.
- In a CRM strategy the information concerning the customers are essential for the customers' analysis to define marketing plans and marketing and selling actions. The information value is so high that the organizational structure design aims to collect, store and make available all the data the selling and post selling cycle produce through the interaction with the customer.

With the field analysis of the two Companies, Player A and Player B, we tested the three questions to compare each player's organizational choices with the results they obtained in the last 3 years from their technologically highly advances CRM strategy. The results indicator we could test was the "average number of months of permanence of the card holder as client". It was not possible to get other companies' data concerning their performances.

The research framework is described with the model of Fig. 2.

The Results of the Research Project

Player A and Player B adopted a CRM strategy to deliver to their customers the highest level of service personalization with an high attention to the costs of the services to maximize the value for the customers and for the firm. Both the Player highly invested in the technological infrastructure making use of the best worldwide ICT solutions in terms of e.g. datamining, datawarehouse and business intelligence systems with the purpose to collect, store, elaborate and analyse great amounts of data produced by the interactions with the customers during the service delivering. Processes are so efficient that the number of data stored in each transactions has become extremely high with nearly 40 information for each telephone call by the client to the Customer Centre or for each mail message received [11–13].

The first choice for the service delivery processes both the Players have done is to diversify the channels through which the customers can contact the operators. Internet is becoming a very important channel. Its wider use reduced of the 15% the 60,000 phone calls received by the Contact Centre on average per day.

Both Players specialized their customers contact operators according to the types and difficulty of the problems in in-bound calls and for customer's target for out-bound calls. The purpose in the labour division is to differentiate the operators in two types: the lower skilled operators who can also be contracted out, and high skilled operators employed by the Credit Card Company whose duty is to solve the most difficult situations when, for example, a customer is leaving. Players B calls Team Leaders the operators with the highest professional skills.

One of the efforts of highest relevance both the players did was to increase the user-friendliness of the Contact Center software applications to reduce the experience, the training and the skills of the customer contact operators. The technological systems power in dealing with the customers' information is so high to produce the substitution of the operators with the automation of the service delivering, at the same time either maintaining an high level of personalization of the service for the customer and reducing costs through the control of the mix of the different types of operators' skills.

As to the last question the analysis showed that the organizational structure design to support the most efficient information use is still an open decision for Player A. At present a critical factor is the separation in two different functional directions of the marketing responsible and of the post selling director. A great amount of information produced by the interaction with the customer are lost and not used to define new marketing plans. Player B solved the problem linking the two direction under the same functional and hierarchical responsibility.

Discussion and Conclusions

The analysis of customer-oriented companies of the credit card sector with an advance CRM strategy based on highly advance technological infrastructures reveals that the organizational decisions are the critical factor either to the processes efficiency and to achieve the strategy objectives. The multiple case analysis of two of the main Italian players in the credit card issuing sector showed the relevance of the organizational decisions to reach a balance between the two opposite objectives of offering a custom-made service delivery to the customers, maintaining a strict control on costs levels to produce the expected value for the customers and for the Company. The achievement of the CRM strategy objectives results depending on a massive use of very powerful technologies either with the wide extension of the automation of service delivery operations offering the customers opportunities of interaction through a variety of channels as alternative option to the Contact Center with an equal level of quality and personalization of the service and simplifying the user-friendliness of the customers contact operators' delivering procedures reducing

the skills, the training and the experience required to the main number of operators maintaining fewer highly skilled of them.

Even the companies of the service sector like the ones considered are facing the phenomenon so called "mass customization" to achieve the objective of the personalization of the service delivery without losing the economic advantages in cost savings of a large scale of production through the extension of the automation of service delivery operations reducing the skills required to customers contact operators.

References

1. Prahalad, C. K. and Ramaswamy, V. (2004). Co-creating unique value with customers. *Strategy and Leadership*. 32: 4–9
2. Prahalad, C. K., Ramaswamy, V., and Krishnan, M. (2000). Consumer centricity. *Information Week*. 781: 67–76
3. Rubin, M. (1997). Creating customer-oriented companies. *Prism*. 4: 5–27
4. Payne, A. and Frow, P. (2005). A strategic framework for customer relationship management. *Journal of Marketing*. 69: 167–176
5. Reinzar, W., Krafft, M., and Hoyer, D. (2004). The customer relationship management process: Its measurement and impact on performance. *Journal of Marketing Research*. 41: 293–305
6. Chen, J. and Popovich, K. (2003). Understanding customer relationship management (CRM). People, process and technology. *Business Process Management Journal*. 9: 672–688
7. Grönroos, C. (1999). Relationship marketing: Challenges for the organization. *Journal of Business Research*. 46: 327–335
8. Farinet, A. and Ploncher, E. (2002). *Customer Relationship Management*. Etas, Milan
9. Milgrom, P. and Roberts, J. (1995). Complementarities and fit. Strategy, structure and organizational change in manufacturing. *Journal of Accounting and Economics*. 19: 179–208
10. Robey, D. and Broudeau, M. (1999). Accounting for the contradictory organizational consequences of information technology. *Information Systems Research*. 10: 167–185
11. Bharadwaj, A. (2000). A resource based perspective on information technology capability and firm performance: An empirical investigation. *MIS Quarterly*. 24:169–196
12. Dewett, T. and Jones, G. R. (2001). The role of information technology in the organization: A review, model, and assessment. *Journal of Management*. 27: 313–346
13. Groth, R. (2000). *Data mining: Building Competitive Advantage*, Upper Saddle River, Prentice Hall

Part IV
Is in Engineering and in Computer Science

B. Pernici

Research in IS, in engineering and computer science covers a wide range of topics. A common basis is the development of models which allow the description of information and business processes in IS and of the logical components of the architectures which can be adopted for their enactment. From an engineering point of view, research topics focus on architectural aspects, security, and design of engineered IS. A particular focus is on cooperative IS based on innovative technologies, such as service oriented approaches. From a computer science perspective, the focus is on algorithms to analyze information, with the goal of retrieving and integrating it. A particular focus is on the analysis of data and information quality. The Track encourages interplay with theory and empirical research and is open to contributions from any perspective. Topics include (but are not limited to): IS architectures; IS design; Security; Cooperative IS; Semantic annotations of data and services; Information quality; Service quality; IS interoperability.

Politecnico di Milano, Milano, Italy, barbara.pernici@polimi.it

Service Semantic Infrastructure for Information System Interoperability

D. Bianchini and V. De Antonellis

Abstract This paper provides an overview of our Semantic Driven Service Discovery approach for internetworked enterprises in a P2P scenario, P2P-SDSD, where organizations act as peers and ontologies are introduced to express domain knowledge related to service descriptions and to guide service discovery among peers. Ontology-based hybrid service matchmaking strategies are introduced both to organize services in a semantic overlay (by means of interpeer semantic links) and to serve service requests.

Introduction

In recent years Information Systems evolved towards distributed architectures relying on P2P technologies, where different internetworked enterprises aim at sharing their functionalities to enable cooperation and interoperability. Capabilities of distributed Information Systems are exported as Web services, featured by their functional interfaces (operations, I/O messages, service categorization) and non-functional aspects (e.g., quality of service). The ever growing number of available services made the automatic service discovery a crucial task to allow provisioning and invocation of Information System functionalities, where the inner semantic heterogeneity of distributed environments must be addressed. Semantics is particularly important to share and integrate information and services in open environments, where a common understanding of the world is missing. Ontologies provide a commonly accepted tool to share descriptions of available resources in a semantic-driven way, offering the benefits of formal specifications and inference capabilities. In open P2P systems, difficulties mainly arise due to the highly dynamic nature of enterprise interoperability, the lack of any agreed-upon global ontology and the need of distributing computation among internetworked organizations when processing

Università di Brescia, Dipartimento di Elettronica per l'Automazione, Brescia, Italy, bianchin@ing.unibs.it, deantone@ing.unibs.it

queries and searching for services to avoid network overload. Service discovery in P2P systems has been addressed by several approaches in literature, where semantics is considered. Some of them constrain to use centralized ontologies [1, 2] or at least a centralized organization of peer registries [3] or admit different ontologies requiring a mediator-based architecture manually defined to overcome the heterogeneities between ontologies. Moreover, some approaches do not consider semantic organization of peers [3, 4] to avoid broadcasting of the request on the network increasing its overload. Our approach aims at enabling effective service discovery through a semantic overlay that properly relates services distributed over the network to speed up query propagation and discovery mechanism. We propose the Semantic Driven Service Discovery approach for internetworked enterprises in a P2P scenario, P2P-SDSD, where organizations act as peers and ontologies are introduced to express knowledge related to service descriptions and to guide service discovery among peers. Ontology-based hybrid service matchmaking strategies are exploited both to organize services in a semantic overlay (through the definition of interpeer semantic links among services stored on distinct peers) and to serve service requests between enterprises. This paper provides an overview of P2P-SDSD approach and is organized as follows: Section "Network Architecture" introduces the network architecture for P2P service discovery; semantic-enhanced descriptions of services and their organization on the network are presented in section "Service Semantic Model", where we briefly show how our approach deals with dynamic and heterogeneous nature of open P2P systems, while section "P2P Service Discovery" shows how to exploit semantic links for discovery purposes; final considerations are given in section "Conclusions".

Network Architecture

Internetworked enterprises which cooperate in the P2P network can play different roles: (a) to search for services that must be composed in order to execute enterprise business workflow (requester); (b) to store services in semantic-enhanced registries and to propose a set of suitable services when a service request is given, through the application of advanced matchmaking techniques (broker); (c) to publish a new service in a broker (provider). In an evolving collaborative P2P network, an enterprise can contain the description of an available service, while a different enterprise acts as a provider for that service or can be both a requester and a broker. Brokers constitute the core of the distributed architecture, since through them requesters and providers exchange services. In our approach, semantic-enhanced registries on brokers constitute a distributed service catalogue, where functional aspects of services are expressed in terms of service category, service functionalities (operations) and their corresponding input/output messages (parameters), based on the WSDL standard for service representation. Each broker stores its services in a UDDI Registry extended with semantic aspects (called *Semantic Peer Registry*) expressed through its own ontology (called *peer ontology*). Peer ontology is exploited

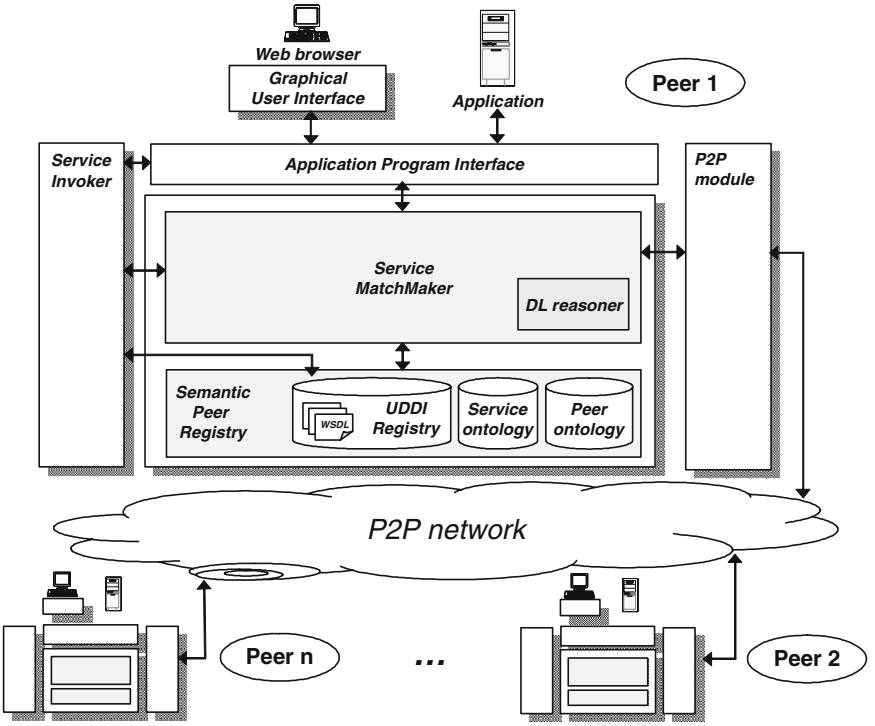


Fig. 1 Peer architecture

by Service MatchMaker, that applies innovative matchmaking strategies to find locally stored services suitable for a given request and to identify similar services stored on different peers, relating them through interpeer semantic links used to speed up service discovery. For each broker, semantically-enhanced service descriptions and references to similar services by means of semantic links are represented inside a Service Ontology, exploited during the discovery phase. Broker architecture is shown in Fig. 1.

Service Semantic Model

Peer ontologies are the core elements of the semantic infrastructure proposed for the distributed Information System architecture. Each peer ontology is constituted by: (a) a *Service Category Taxonomy (SCT)*, extracted from available standard taxonomies, e.g., UNSPSC, NAiCS, to categorize services; (b) a *Service Functionality Ontology (SFO)*, that provides knowledge on the concepts used to express service functionalities (operations); (c) a *Service Message Ontology (SMO)*, that provides knowledge on the concepts used to express input and output messages (parameters)

of operations. Furthermore, the peer ontology is extended by a thesaurus providing terms and terminological relationships (as synonymy, hypernymy and so on) with reference to names of concepts in the peer ontology. In this way, it is possible to extend matchmaking capabilities when looking for correspondences between elements in service descriptions and concepts in the ontology, facing with the use of multiple peer ontologies.

The joint use of peer ontology and thesaurus is the basis of an innovative matchmaking strategy that applies DL-based and similarity-based techniques to compare service functional interfaces. The focus of this paper is to show how information on matching between services can be used to build a semantic overlay on the P2P network, improving discovery efficiency. In the following, we will introduce our hybrid matchmaking model and we will define interpeer semantic links based on match information. More details on hybrid matchmaking techniques can be found in [5]. The match between two services is represented as:

- The kind of match between them, to assert that two interfaces (a) provide the same functionalities and work on equivalent I/O parameters (total match), (b) have overlapping functionalities or parameters, providing additional capabilities each other (partial match) or (c) have no common capabilities (mismatch), as summarized in Table 1.
- The similarity degree, to quantify how much services are similar from a functional viewpoint, obtained applying properly defined coefficients that evaluate terminological similarity between the names of operations and I/O parameters [6].

Matchmaking is organized into five steps:

- *Pre-filtering*, where service categories are used to select a set of supplied services, called *candidate services*, that have at least one associated category related with the category of ***R*** in any generalization hierarchy in the SCT

Table 1 Classification of match types between a request R and a supplied service S

Type of match	Description
EXACT	***S*** and ***R*** have the same capabilities, that is, they have: (a) equivalent operations; (b) equivalent output parameters; (c) equivalent input parameters
PLUG-IN	***S*** offers at least the same capabilities of ***R***, that is, names of the operations in ***R*** can be mapped into operations of ***S*** and, in particular, the names of corresponding operations, input parameters and output parameters are in any generalization hierarchy in the peer ontology
SUBSUME	***R*** offers at least the same capabilities of ***S***, that is, names of the operations in ***S*** can be mapped into operations of ***R***; it is the inverse kind of match with respect to Plug-in
INTERSECTION	***S*** and ***R*** have some common operations and some common I/O parameters, that is, some pairs of operations and some pairs of parameters, respectively, are related in any generalization hierarchy in the peer ontology
MISMATCH	Otherwise

- *DL-based matchmaking*, where the deductive model is applied between a pair of service descriptions, the request and each candidate service, to establish the kind of match
- *Similarity-based matchmaking*, where similarity degree between request and each candidate service is evaluated; EXACT and PLUG-IN match denote that the candidate service completely fulfills the request and service similarity is set to 1.0 (full similarity); if MISMATCH occurs, the similarity value is set to 0.0; finally, SUBSUME and INTERSECTION match denote partial fulfilment of the request and, in this case, similarity coefficients are actually applied to evaluate the degree of partial match; we will call ***GSim*** ($\in$[0,1]) the overall service similarity value
- *Pruning*, where candidate services are filtered out if the kind of match is mismatch or the ***GSim*** value doesn't reach a pre-defined threshold given by experimental results
- *Ranking*, where final matching results are sorted according to the kind of match (EXACT > PLUG-IN > SUBSUME > INTERSECTION) and the ***GSim*** value.

Match information are fruitfully exploited to build the semantic overlay. In particular, given a broker *p*, interpeer semantic links with respect to the other brokers are established by applying the matchmaking algorithm with reference to peer ontology and thesaurus of *p*.

Definition 1 (Interpeer semantic links). Given a pair of services $\mathbf{S_1}$ stored on a broker p (with peer ontology $\mathbf{PO_p}$ and thesaurus $\mathbf{TH_p}$) and a service $\mathbf{S_2}$ stored on a broker q (with peer ontology $\mathbf{PO_q}$ and thesaurus $\mathbf{TH_q}$ not necessarily coincident with $\mathbf{PO_p}$ and $\mathbf{TH_p}$), an interpeer semantic link between $\mathbf{S_1}$ and $\mathbf{S_2}$ denoted with $\mathrm{sl}_{\mathrm{p}\rightarrow\mathrm{q}}(\mathbf{S_1},\mathbf{S_2})$, is a 4-uple:

$$\langle \mathbf{S_1}, \mathbf{S_2}, \mathrm{MatchType}, \mathbf{GSim}(\mathbf{S_1}, \mathbf{S_2}) \rangle$$

where `MatchType` $\in$ {EXACT, PLUG-IN, SUBSUME, INTERSECTION}, obtained by applying matchmaking algorithm with respect to $\mathbf{PO_p}$ and $\mathbf{TH_p}$. The broker q is a semantic neighbor of p with respect to the service $\mathbf{S_1}$.

To setup interpeer semantic links a broker *p* produces a *probe service request* for each service $\boldsymbol{S_i}$ it wants to make sharable; this probe service request contains the description of the service functional interface of $\boldsymbol{S_i}$ and the IP address of *p* and is sent to the other brokers in the P2P network connected to *p*. A broker receiving the probe service request matches it against its own service descriptions by applying the matchmaking techniques and obtains for each comparison the `MatchType` and the similarity degree. If the `MatchType` is not MISMATCH and the similarity degree is equal or greater than the predefined threshold, they are enveloped in a message sent back to the broker *p* from which the probe service request came. An interpeer semantic link is established between the two brokers, that become *semantic neighbors* with respect to the linked services. The network can evolve when a new internetworked enterprise joins it or a provider publishes a new service (that is, it makes available an additional functionality). The probe service request mechanism is applied among brokers to update the overlay of interpeer semantic links.

P2P Service Discovery

The network of interpeer semantic links constitute the semantic overlay and is part of the semantic infrastructure together with peer ontology and thesaurus. Such infrastructure is exploited during service discovery, performed in two phases: (a) an enterprise acting as broker receives a service request ***R*** either directly from a requester or from another broker and matches it against service descriptions stored locally finding a set ***CS*** of matching services; (b) the service query is propagated towards semantic neighbors exploiting interpeer semantic links according to different forwarding strategies. In the following, we will consider two strategies. In the first case, search stops when a relevant matching service which provides all the required functionalities is found on the net. The strategy is performed according to the following rules:

- Service request R is not forwarded towards peers that have no semantic links with services Si ∈ CS.
- Service request R is forwarded towards semantic neighbors whose services provide additional capabilities with respect to services Si ∈ CS (according to the kind of match of the interpeer semantic link); according to this criterion, if a service Si ∈ CS presents an Exact or a Plug-in match with the request R, then Si satisfies completely the required functionalities and it is not necessary to forward the service request to semantic neighbors with respect to Si; if Si presents a Subsume or an Intersection match with the request R, the request is forwarded to those peers that are semantic neighbors with respect to Si, without considering semantic neighbors that present a Subsume or an Exact match with Si, because this means that they provide services with the same functionalities or a subset of Si functionalities and they cannot add further capabilities to those already provided by Si.
- If it is not possible to identify semantic neighbors for any service Si ∈ CS, service request R is forwarded to a subset of all semantic neighbors (randomly chosen), without considering local matches, or to a subset of peers (according to its P2P network view) if no semantic neighbors have been found at all.

The second strategy follows the same rules, but it does not stop when a relevant matching service is found. In fact, if a service $\boldsymbol{S_i} \in \boldsymbol{CS}$ presents an EXACT or a PLUG-IN match, the service request ***R*** is forwarded to semantic neighbours with respect to $\boldsymbol{S_i}$, since the aim is to find other equivalent services that could present better non-functional features. The search stops by applying a time-out mechanism. For the same reason, also semantic neighbours that present a SUBSUME or an EXACT match with $\boldsymbol{S_i}$ are considered.

Selection of semantic neighbours is performed for each $\boldsymbol{S_i} \in \boldsymbol{CS}$. Each selected semantic neighbour ***sn*** presents a set of k interpeer semantic links with some services $\boldsymbol{S_1} \ldots \boldsymbol{S_k} \in \boldsymbol{CS}$, featured by $\boldsymbol{GSim_1} \ldots \boldsymbol{GSim_k}$ similarity degree and $\boldsymbol{mt_1} \ldots \boldsymbol{mt_k}$ kind of match, respectively. The relevance of ***sn*** does not depend only on the similarity associated to the interpeer semantic links towards ***sn***, but also on the similarity degree between $\boldsymbol{S_i} \in \boldsymbol{CS}$ and ***R***. Therefore, the harmonic mean is used to combine

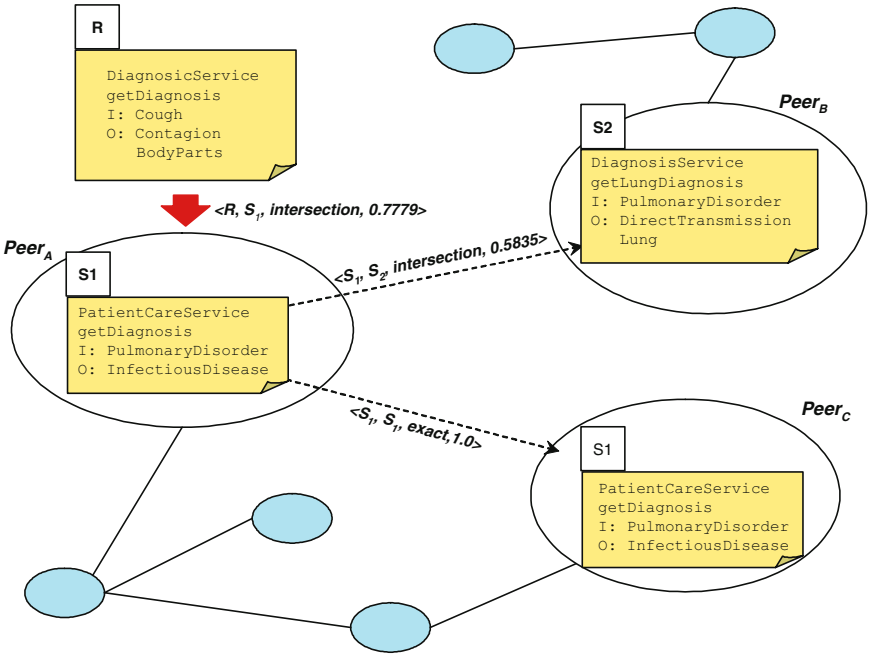


Fig. 2 Exploitation of interpeer semantic links for the running example

these two contributions and the relevance of a semantic neighbour ***sn*** is defined as:

$$r_{sn} = \frac{1}{k}\sum_{i=1}^{m_{sn}} \frac{2^{*}GSim_i{}^{*}GSim(R,S_i)}{GSim_i + GSim(R,S_i)} \tag{1}$$

Relevance values are used to rank the set of semantic neighbours in order to filter out not relevant semantic neighbours (according to a threshold-based mechanism).

Example 1. Let's consider three (broker) peers, where $\texttt{Peer}_\texttt{A}$ and $\texttt{Peer}_\texttt{C}$ adopted the same reference peer ontology and thesaurus and provide the same diagnostic service $\boldsymbol{S_1}$, while $\texttt{Peer}_\texttt{B}$ adopted a different peer ontology and thesaurus and provides service such that match $(\boldsymbol{S_1}, \boldsymbol{S_2}) = \text{INTERSECTION}$ and $\boldsymbol{GSim}(\boldsymbol{S_1}, \boldsymbol{S_2}) = 0.58$. Let's suppose that, given a request $\boldsymbol{R}$ sent to the $\texttt{Peer}_\texttt{A}$, by applying matchmaking procedure we obtain match $(\boldsymbol{R}, \boldsymbol{S_1}) = \text{INTERSECTION}$ with $\boldsymbol{GSim}\ (\boldsymbol{R}, \boldsymbol{S_1}) = 0.78$. The interpeer semantic links that are identified in this example are depicted in Fig. 2. In this example:

$\boldsymbol{CS} = \{ <\boldsymbol{S_1}, \text{INTERSECTION}, 0.78> \}$. The set of semantic neighbors $\boldsymbol{SN}$ of $\texttt{Peer}_\texttt{A}$ is:

$< \texttt{Peer}_\texttt{B}, \{ <\boldsymbol{S}_1, \boldsymbol{S}_2, \text{INTERSECTION}, 0.58> \} >$,
$< \texttt{Peer}_\texttt{C}, \{ <\boldsymbol{S}_1, \boldsymbol{S}_1, \text{EXACT}, 1.0> \} >$ with values:

$$r_{Peer_B} = \frac{2^{*}0.58^{*}0.78}{0.58+0.78} = 0.67 \; r_{Peer_C} = \frac{2^{*}1.0^{*}0.78}{1.0+0.78} = 0.88 \tag{2}$$

For what concerns the first forwarding strategy, request $\boldsymbol{R}$ should not be sent to $\texttt{Peer}_\texttt{C}$, since it does not provide any additional functionality with respect to those already provided by $\boldsymbol{S_1}$ on $\texttt{Peer}_\texttt{A}$. Furthermore, service $\boldsymbol{S_2}$ on $\texttt{Peer}_\texttt{B}$ could provide additional required functionalities with respect to service $\boldsymbol{S_1}$ on $\texttt{Peer}_\texttt{A}$, request $\boldsymbol{R}$ is then forwarded only to $\texttt{Peer}_\texttt{A}$, where a PLUG-IN match is found with $\boldsymbol{S_2}$. However, according to the second proposed forwarding strategy, request $\boldsymbol{R}$ is forwarded also to $\texttt{Peer}_\texttt{C}$ in order to find services providing the same functionalities, but with different non-functional features, since both semantic neighbors are characterized by high relevance values. Anyway, only peers related by means of interpeer semantic links (if any) are involved in the forwarding strategy.

Conclusions

In this paper, we presented a P2P service discovery approach, based on a semantic overlay which organizes services by means of semantic links, in order to improve performances during service discovery. Ontologies are used to add semantics to service descriptions extending traditional UDDI Registry. Moreover, heterogeneity in P2P systems is considered, without constraining peers to use the same reference ontology. Experiments have been performed to confirm the advantages derived from a combined use of peer ontology and thesaurus in absence of a global ontology and to demonstrate better precision-recall results of our approach with respect to other service matchmaking strategies [7]. Further experimentation will evaluate the impact of the proposed approach on service discovery in P2P networks according to well-known parameters (such as network overload) and concrete applications (e.g., scientific collaboration in medicine between healthcare organizations).

References

1. Arabshian, K. & Schulzrinne, H. (2007). An Ontology-Based Hierarchical Peer-to-Peer Global Service Discovery System. *Journal of Ubiquitous Computing and Intelligence*, 1(2): 133–144
2. Banaei-Kashani, F., Chen, C., & Shahabi, C. (2004). WSPDS: Web Services Peer-to-Peer Discovery Service. *Proceedings of the International Conference on Internet Computing (IC '04)*, pages 733–743, Las Vegas, Nevada, USA
3. Verma, K., Sivashanmugam, K., Sheth, A., Patil, A., Oundhakar S., & Miller, J. (2005). METEOR-S WSDI: A Scalable Infrastructure of Registries for Semantic Publication and Discovery of Web Services. *Journal of Information Technology and Management, Special Issue on Universal Global Integration*, 6(1):17–39
4. Paolucci, M., Sycara, K.P., Nishimura, T., & Srinivasan, N. (2003). Using DAML-S for P2P Discovery. *Proceedings of the International Conference on Web Services (ICWS2003)*, pages 203–207, Las Vegas, Nevada, USA
5. Bianchini, D., De Antonellis, V., Melchiori, M., & Salvi, D. (2006). Semantic-Enriched Service Discovery. *IEEE ICDE International Workshop on Challenges in Web Information Retrieval and Integration, WIRI 2006*, pages 38–47, Atlanta, Georgia, USA

6. Bianchini, D., De Antonellis, V., Pernici, B., & Plebani, P. (2006). Ontology-Based Methodology for e-Service Discovery. *Journal of Information Systems, Special Issue on Semantic Web and Web Services*, 31(4–5):361–380
7. Bianchini, D., De Antonellis, V., Melchiori, M., & Salvi D. (2007). Service Matching and Discovery in P2P Semantic Community. *Proceedings of the 15th Italian Symposium on Advanced Database Systems (SEBD'07)*, pages 28–39, Fasano (Brindisi), Italy

A Solution to Knowledge Management in Information-Based Services Based on Coopetition. A Case Study Concerning Work Market Services

M. Cesarini[1], M.G. Fugini[2], P. Maggiolini[3], M. Mezzanzanica[1], and K. Nanini[3]

Abstract We are investigating how "coopetition" (*Co-opetition*, New York: Doubleday & Company, 1996; EURAM, Second Annual Conference – Innovative Research in Management, Stockholm, 9–11 May 2002) can improve information-based services by fostering knowledge sharing while safeguarding both competitive interests and business objectives of the involved actors. We explore the issues related to the development and to the governance of a coopetitive scenario. Furthermore, we explore the network forms of organization for modelling large coopetitive settings. In this paper we present a case study concerning the job marketplace intermediation services, namely the Borsa Lavoro project (http://www.borsalavorolombardia.net, 2004), whose goal is to create a job e-marketplace in the Italian Lombardy region. The analysis of the Borsa Lavoro achievements and results provides useful insights about issues arising in a coopetitive setting. We interpret such results according to the coopetitive model and according to the network form of organizations theory.

Introduction

In recent years, public administrations have undergone strong changes regarding the way they provide public services. Most of the traditional (often state based) monolithic service infrastructures have developed into networks of service providers, where the network is composed by independent (even private) actors [4]. Such an evolution is required to cope with more and more complex scenarios. For example, in Italy the Biagi Laws [5, 6] broke the job intermediation state monopoly by

[1]Università degli Studi di Milano Bicocca, Dipartimento di Statistica, Milano, Italy, mirko.cesarini@unimib.it, mario.mezzanzanica@unimib.it
[2]Politecnico di Milano, Dipartimento di Elettronica e Informatica, Milano, Italy, fugini@elet.polimi.it
[3]Politecnico di Milano, Dipartimento di Ingegneria Gestionale, Milano, Italy, piercarlo.maggiolini@polimi.it

enabling the activities of private entities. Still, such a law obliges all the intermediaries to share job demands and offers. The rationale is to preserve the information transparency previously assured by the existence of the single monopolistic intermediary. As a consequence, a large ICT infrastructure has been built to support information sharing among the Italian job intermediaries. A similar system was built in Australia: "Job Network" [7] is an Australian Government funded network of service providers supporting citizens in seeking employment. The network is a competitive organization with private and community organizations (e.g. charities) competing to each other for delivering employment services. In the European context, the SEEMP project is developing an interoperability infrastructure based on semantic Web Services and a set of local ontologies of labor market concepts [8] to interconnect public and private actors in a federation.

The need of complex services has fostered the development of a new discipline, called Service Science [9]. Nowadays, complex services require several actors to collaborate, but the collaboration of independent actors raises some issues. First of all some of these actors may be competitors, and although they could cooperate on some specific tasks, they might be worried of doing that. A "coopetitive model" can describe the interaction taking place in such a situation. The term *coopetition* is used in management literature to refer to a hybrid behavior comprising competition and cooperation. Coopetition takes place when some actors both *cooperate* in some areas and *compete* in some others. Some authors [10, 11] have recently emphasized the increasing importance of coopetition for today's inter-firm dynamics; however, scientific investigation on the issue of coopetition has not gone much further.

We claim that coopetition is an important research topic and can provide a solution to Knowledge Management Problems as well as to the development of Information-based Services. Furthermore, coopetition can model new businesses and scenarios providing a balance among the benefits of cooperation (e.g., scale economies, cost reduction, knowledge sharing) and the benefits of competition (efficiency, quality, economies of scope).

This paper addresses the issues related to the design, development, and governance of large coopetitive settings providing a solution to knowledge management problems in information-based services.

The paper is organized as follows: Section "Main Issues in Building Coopetitive Knowledge Sharing Systems" points out the main issues arising during the process of building a coopetitive knowledge sharing system, section "Governance Issues in Coopetitive Settings" focuses on the governance issues of large coopetitive settings, section "A Case Study: Borsa Lavoro Lombardia" presents a case study and finally section "Conclusions and Future Work" draws some conclusions and outlines future work.

Main Issues in Building Coopetitive Knowledge Sharing Systems

Public administrations and companies own large data assets which can be used to provide information based services. Information based service needs a customized

design; nevertheless, in this section we focus on common issues that have to be addressed in order to build a coopetitive setting to providing information based services. Such issues are:

- Motivating the actors involved in the service provisioning by means of incentives, by showing market opportunities, and in general by exploiting all the available levers.
- Building the required ICT infrastructure, e.g. connecting the actors information systems in order to build a federated system, or adapting the legacy systems when required.
- Building a sustainable governance able to actively foster the participation of the actors, required to build the system.

Concerning the actors involvement, every coopetitive scenario relies on some kind of collaboration among the involved actors, who may, or may not, be willing to collaborate or even may try to cheat, namely to exploit other actors collaboration against their interests. This can be summarized by saying that a balance should be established among the following factors: cooperative aptitude, competitive aptitude, extension of the sectors where a conflict between cooperation and coopetition takes place, possibility and convenience to cheat, convenience to collaborate.

The way a balance can be reached depends on the context domain, on the policies and on the overall adopted governance model. Depending on each specific scenario, fostering the coopetition may be an easy task or may become a very challenging activity [12]. Policy making has a big impact on establishing a successful coopetition. In [12] different policies are shown and evaluated for the same scenario. We are not focusing on policy making in this paper, but rather we investigate the overall governance model for a coopetitive scenario. The policies can be seen as the specific output of the chosen governance model.

Time plays an important role during the construction of a coopetitive scenario as well. As a matter of fact, even in the case where joining a coopetitive setting is strongly convenient for the actor, it is likely that the expectations decrease if too much time is necessary to have the coopetitive scenario fully working. In this case, a kind of negative feeling arises among the actors, which prevents a full active participation of the partners to the coopetition. Such a situation is likely to cause the failure of the coopetitive project. Therefore, it has to be considered carefully.

The issue of building an ICT infrastructure is a very broad topic, therefore we are not addressing it in this paper. We just mention that the cost of modifying an information system in order to provide data to a different system is very low compared to the annual incomes or budgets of the companies owning the systems; therefore this topic can be neglected [13] from the business point of view. From the technical point of view, we recall that new technologies (e.g. web services) allow the creation of federated information systems with minimal invasiveness into the legacy systems.

Finally, building a sustainable governance able to actively foster the participation of the system actors is a crucial issue, and we focus on it in the sequel of the paper.

Governance Issues in Coopetitive Settings

Large and complex structures providing services, especially public services, are usually managed according to hierarchical management models. However, as reported in [14], the traditional hierarchical approach is not feasible in a coopetitive setting of independent, although competing, actors, since there are no direct hierarchical relationships among the involved entities. Hence, the management is required to switch to a negotiation model, through which the desired goals have to be reached by means of negotiation with the involved actors and by means of incentives. Negotiation and incentives should be taken into account also during the design, the project start-up, and the maturity phases [12]. Given such premises, let us investigate how a governance model can effectively exploit such models and tools.

The relationships emerging in a complex coopetitive scenario can be successfully modeled by the network form of organizations (hereafter *network*). The network is an organizational model involving independent actors combining both competitive and collaborative aspects, thus is a good candidate for studying complex coopetitive settings. The expression "network forms of organization" refers to two or more organizations involved in long-term relationships [15] and the first studies in this field have been carried out by [16]. An interesting evolution process of network forms of organization articulated in several phases has been described by [17]. According to this model, a network form develops in three phases, each with particular and important social aspects. The first phase is a preparatory one, where personal relationships are established and a good reputation of the involved people is established. During the second phase, the involved actors start exploiting mutual economic advantages from their relationship. During a trial period, the actors check incrementally their competences and their availability to cooperate. A positive ending is the result of the incremental growth of trust and the evolution of reciprocity norms during that period.

The network governance task consists in establishing some coordination mechanism to reach the desired goals. The main goals of a generic network aimed at producing information based services are: to promote actors participation (especially the key-players and the actors having a primary role in the scenario) and to coordinate the information flows necessary to build the information services.

The optimal mix of coordination mechanisms strongly depends on the complexity of the goals to be reached, the cost of the involved transactions, and the network complexity. The coordination model can belong to two antithetic forms: a network where the actors are self coordinated and a network where the coordination effort is delegated to a specific part of the network (e.g., a committee, or a stakeholder). Self coordination works well with small networks and simple goals, while complex networks having complex goals require a specific organizational unit in charge of coordinating the activities. As a matter of fact, trust and reciprocity can not arise shortly in complex networks pursuing complex goals; therefore, a central committee is required for coordinating the activities. For this reason, many public administrations play the role of relationships coordinators in networks providing complex public services.

There is no silver bullet for selecting the right governance, since each network needs an ad-hoc governance model which has to be accurately designed. Considering networks composed of both public and private actors in charge of providing public services, some more recommendations can be provided:

- Agreements among several organizations have to be established, with the purpose of sharing the information assets and to interconnect the information systems of the involved organizations.
- The tasks of planning, evaluating, and assessing the network activities should be shared among the service providers participating in the network.
- The network activities should be assigned to the participating actors without overcoming the boundaries of their competences.

A Case Study: Borsa Lavoro Lombardia

Borsa Lavoro Lombardia is an example of federated network providing public services to the Labour Market, where private and public actors participate under the coordination of a public administration, namely "Regione Lombardia".

"Borsa Lavoro Lombardia" (BLL hereafter) is a federated information system aiming at exchanging information about offers and requests in the job market place. BLL provides several services addressing the issues of human capital growth as well (e.g. training, vocational training, information provision, ...). Concerning the job offers and requests, the aim of the federation is to create a global virtual job market place where job seekers can upload their curriculum and the enterprises can upload their vacancy descriptions. The job seekers can access vacancy descriptions without being limited to the boundaries of a local job agency. The federation has been conceived to preserve the possibility of performing business by the participants (e.g. private job agencies), an ad hoc data management model allows to reach such a goal. Anonymous versions of curriculum vitae (CV) or job offers are shared by the intermediaries through the BLL system and are used to perform the CV/job offer matching. Upon successful matching, the involved intermediaries (either job agencies or public employment offices) are notified. Contact details are shared between the involved intermediaries according to precise business rules.

The set of private job agencies, public employment offices, and vocational training centers being part of the BLL can be modelled through the network forms of organization previously introduced. Thus, public and several private actors participate in the BLL building a coopetitive setting. Each job intermediary participating in the BLL should agree on some rules regulating the way of transferring and sharing data. The BLL rules are established by Regione Lombardia, the public administration in charge of managing the actors coordination.

The overall results in terms of efficiency and benefits, although positive considering that BLL is in place since 2004, are somehow disappointing with respect to what expected. In [18] three possible hypothesis about failures were investigated. A further hypothesis is that the actors involved in the network (especially the job

intermediaries) did not adequately develop the trust and the reciprocity links necessary to speed up the BLL system. We are currently evaluating such hypothesis basing on the statistical data provided by the BLL [19] and by the Italian Institute of Statistics [20].

Conclusions and Future Work

In this paper we have investigated the information-based services provided within the context of "coopetitive" scenarios. We identified the governance as one of the core issues in such contexts and we have used the network forms of organization for studying the governance issues of large coopetitive settings. We have presented a case study (the "Borsa Lavoro Lombardia" project) where services supporting the job marketplace activities are provided through a coopetitive network of public and private actors, coordinated by a public administration. As a future work, we plan to check if some inadequate performance of the "Borsa Lavoro Project" can be explained using the theory of the networks form of organizations.

References

1. Brandenburger, A. M. and Nalebuff, B. J. (1996) *Co-opetition*. Doubleday & Company, New York
2. Dagnino, G. B. and Padula, G. (2002) Coopetition Strategy a new kind of Inter-firm Dynamics for Value Creation, EURAM – The European Academy of Management, Second Annual Conference – "Innovative Research in Management", Stockholm, 9–11 May
3. Borsa Lavoro Lombardia (2004). http://www.borsalavorolombardia.net
4. Kuhn, K. A. and Giuse, D. A. (2001) From hospital information systems to health information systems. Problems, challenges, perspectives. *Methods of Information in Medicine*, 40(4):275–287
5. Biagi, Law n. 30, 14th February (2003) "Delega al Governo in materia di occupazione e mercato del lavoro", published on "Gazzetta Ufficiale" n. 47, 27 February 2003, Italy
6. Biagi, Government Law (2003) (decreto legislativo) n. 276, 10th September 2003, "Attuazione delle deleghe in materia di occupazione e mercato"
7. Job Network. (1998) http://jobsearch.gov.au
8. Cesarini, M., Celino, I., Cerizza, D., Della, Valle E., De Paoli, F., Estublier, J., Fugini, M., Guarrera, P., Kerrigan, M., Mezzanzanica, M., Gutowsky, Z., Ramìrez, J., Villazón, B., and Zhao, G. (2007) SEEMP: A Marketplace for the Labour Market. in Proceedings Of the E-Challenges Conference, October, The Hague, IOS Press
9. Chesbrough, H. and Spohrer, J. (2006) A research manifesto for services science. *Communication ACM*, 49(7):35–40
10. Gnyawali, D. R. and Madhavan, R. (2001) Cooperative networks and competitive dynamics: A structural embeddedness perspective. *Academy of Management Review*, 26(3):431–445
11. Lado, A., Boyn, N. and Hanlon, S. C. (1997) Competition, cooperation, and the search for economic rents: A syncretic model. *Academy of Management Review*, 22(1):110–141
12. Cesarini, M. and Mezzanzanica, M. (2006) Policy Making for Coopetitive Information Systems. In Proceedings of the International Conference on Information Quality, ICIQ, MIT, Boston

13. Mezzanzanica, M. and Fugini, M. (2003) An Application within the Plan for E-Government: The Workfare Portal, Annals of Cases on Information Technology (ACIT), Journal of IT Teaching Cases, IDEA Group Publisher, Volume VI
14. Cesarini, M., Mezzanzanica, M., and Cavenago, D. (2007) ICT Management Issues in Healthcare Coopetitive Scenarios. In Information Resources Management Association International Conference, Vancouver, CA, November
15. Thorelli, H. (1986) Networks: Between markets and hierarchies. *Strategic Management Journal*, 7(1):37–51
16. Powell, W. (1990) Neither market nor hierarchy: network, forms of organization. *Research in Organizational Behavior*, 12(4):295–336
17. Larson, A. (1992) Network dyads in entrepreneurial settings: A study of the governance of exchange relationships. *Administrative Science Quarterly*, 37(1)
18. Cesarini, M., Mezzanzanica, M., Fugini, M., Maggiolini, P., and Nanini, K. (2007) "Coopetition", a Solution to Knowledge Management Problems in Information-based Services? A Case Study Concerning Work Market Services, in Proceedings of the XVII International RESER Conference European Research Network on Services and Space, Tampere, Finland
19. Borsa Lavoro Lombardia Statistics (2006) http://www.borsalavorolombardia.net/pls/portal/url/page/sil/statistiche
20. ISTAT (2007) Report on workforces (in Italian), "Rilevazione sulle forze lavoro, serie storiche ripartizionali", I trimestre, http://www.istat.it/salastampa/comunicati/in_calendario/forzelav/20070619_00/

Part V
Governance, Metrics and Economics of IT

C. Francalanci

IT Governance has been constantly representing a major top management challenge. IT is continuously evolving and new technologies raise novel management issues that require specific techniques to be assessed, diagnosed and controlled. These techniques are largely based on metrics to support governance with quantitative evidence. Metrics have been designed for all technical and organizational components of a company's IS, including: design and management skills (literacy, maturity, change management and flexibility, IT accounting); strategic capabilities (investment planning, IT-organizational alignment, supplier/contract management, service innovation); Software quality, costs, and development process maturity. Hardware quality of service (availability, response time, recovery time) and costs (acquisition, installation, management and maintenance). Network quality of service (availability, dependability, traffic profile, delay, violation probability, bandwidth). A continuous research effort is necessary to design, test, and implement new metrics and related tools. The goal of this track is to understand the state of the art and current research directions in the field of IT metrics for governance. The track should focus on the most recent developments of IT and provide insights on related IT economics, costs, and benefits, technological and organizational metrics, as well as their application in governance.

Politecnico di Milano, Milano, Italy, francala@elet.polimi.it

Analyzing Data Quality Trade-Offs in Data-Redundant Systems

C. Cappiello[1] **and M. Helfert**[2]

Abstract For technical and architectural reasons data in information systems are often redundant in various databases. Data changes are propagated between the various databases through a synchronization mechanism, which ensures a certain degree of consistency. Depending on the time delay of propagating data changes, synchronization is classified in real time synchronization and lazy synchronization in case of respectively high or low synchronization frequency. In practice, lazy synchronization is very commonly applied but, because of the delay in data synchronization, it causes misalignments among data values resulting in a negative impact on data quality. Indeed, the raise of the time interval between two realignments increases the probability that data result incorrect or out-of-date. The paper analyses the correlation between data quality criteria and the synchronization frequency and reveals the presence of trade-offs between different criteria such as availability and timeliness. The results illustrate the problem of balancing various data quality requirements within the design of information systems. The problem is examined in selected types of information systems that are in general characterized by high degree of data redundancy.

Introduction

Data replication and redundant data storage are fundamental issues that are widespread in many organizations for different reasons. There are a variety of applications that require the replication of data, such as data warehouses or information systems, whose architectures are composed by loosely-coupled software modules that access isolated database systems containing redundant data (i.e. distributed information systems, multichannel information systems). In such environments, a mechanism for synchronizing redundant data is required since the same data are

[1]Politecnico di Milano, Milano, Italy, cappiell@elet.polimi.it
[2]Dublin City University, Dublin, Ireland, markus.helfet@computing.ie

contained in more than one database. Indeed, the portion of data that is overlapped between multiple databases has to be realigned to ensure a definite level of consistency and correctness of data, and consequently provide a high-level of data quality. In fact, in order to improve data quality the ideal approach would be using an online synchronization. This results in a immediate synchronization and assures that all the databases contain at all times the same data values. But on the other side, the idealistic online synchronization implies very high costs. Since it is necessary to consider service and data quality requirements as well as technological constraints, the design and the management of synchronization processes are quite difficult. In particular, it is complex to determine the best synchronization frequency for the realignment process. Data quality is a multidimensional context and the literature provides a set of quality criteria that can be used to express a large variety of user requirements. Data quality criteria are usually classified along different dimensions that analyze the characteristics of data from different perspectives.

Considering both data quality requirements and system costs, the paper analyses the problem of determine a specific synchronization frequency and evaluates its impact. This paper aims to show how the proportional correlation between data quality and frequency of synchronization is not a general assumption but there are trade-offs among the different dimensions. The paper is structured as follows. Section "Synchronization Issues in Data-Redundant Information Systems" describes significant scenarios of data-redundant information systems and illustrates their critical processes for data alignment. Based on this, in section "The Data Quality Perspective" effects of synchronization on data quality are discussed. The obtained results highlight the presence of trade-offs between different data quality criteria, which have to be considered in order to define a most suitable synchronization frequency. Conclusions and future work are summarized in section "Conclusions".

Synchronization Issues in Data-Redundant Information Systems

Data-redundant information systems can be defined as type of information systems in which for architectural or technical reasons data are replicated in different logical and physical detached database instances. In such environments, a mechanism for synchronizing redundant data is required. In the literature different algorithms for data synchronization are proposed (i.e. [1]). Depending on the time delay of propagating data changes, synchronization is classified as real time synchronization and lazy synchronization in case of respectively high or low synchronization frequency. Real time synchronization has been used in timely critical applications in which the volatility of the data is of fractions of seconds. Conversely, lazy synchronization defers the propagation of data changes. Note that the raise of the time interval between two realignments increases the probability that data result incorrect because of its out-of-dateness. In fact, the immediate propagation of data changes through all the sources included in the system would assure the updateness of the values. Thus, in order to guarantee data freshness, an integrated architecture with a central database would be the ideal solution but this is not always feasible. For example, many

distributed databases applications need data replication in order to improve data availability and query response time. Data availability is improved because replica copies are stored at nodes with independent failure modes. Query response time is improved because replica copies are stored at the nodes where they are frequently needed. In other cases data replication is an implicit requirement, as for instance in data warehouse or decision support systems in which data are replicated to be aggregate and queried. All these systems have clearly different data requirements and this mainly influences design decisions about the synchronization mechanism and in particular regarding the synchronization frequency. In this paper we aim at analyzing how design choices for the most suitable frequency vary for selected system typologies from a data quality perspective.

The Data Quality Perspective

Data quality has been defined in different ways in the literature. One possible definition is "the measure of the agreement between the data views presented by an information system and that same data in the real world" [2, 3]. Data quality is a multidimensional concept, that identifies a set of dimensions able to describe different characteristics of data. The literature provides numerous definitions and classifications of data quality dimensions analyzing the problem in different contexts and from different perspectives. The large amount of approaches is caused by the subjective nature of the matter that is often stated in literature. Common examples of data quality dimensions are accuracy, completeness, consistency, timeliness, interpretability, and availability. In general data quality dimensions are evaluated regardless the dynamic behavior of the information system and how decisions about timing impact data quality. As we discussed in section "Synchronization Issues in Data-Redundant Information Systems", focusing on the synchronization process it is important to analyze the impact and effects of the delays of propagating updates on the utilization of data. Previous researches show that dimensions that are associated with data values such as correctness (also known as accuracy) and completeness are influenced from the synchronization mechanism and in particular from the frequency of realignments [4]. Considering dimensions related to data values, it is stated that data quality increases with the increasing of the synchronization frequency. Indeed, the immediate propagation of data changes through all the sources included in the system would assure the updateness of the values. Therefore, increasing the synchronization frequency has positive effects on data quality.

In this paper we focus on criteria that are associated with the usage of data and the processes in which they are involved, such as the data availability and the timeliness. Data availability describes the percentage of time that data are available due to the absence of write-locks caused by update transactions [5]. Moving away from a database perspective and proceeding with a transfer process perspective let us consider timeliness as critical dimension in data-redundant systems. Defined as the extent to which data are timely for their use, timeliness depends on two factors: the time instant in which data are inserted in the sources or transferred to another system (i.e. data warehouse) [5], and the data volatility.

We can assume that between data quality dimensions a trade-off exists. In a situation where the frequency of synchronization is very high, the system is able to guarantee updated information with a high degree of timeliness while the availability of the system is low, since the sources are often locked for loading data. On the contrary, if the frequency of synchronization is low, the availability of the system is high and because of the reduced data freshness, the timeliness is low. In order to identify the most suitable realignment frequency it is necessary to define the quality requirements. For this reason, it is possible to model the data quality level as an aggregate dimension for quality (DQ) that could be obtained applying a weighed sum of all the criteria $(\mathrm{DQC_i})$ that are considered for the evaluation of the quality of the information:

$$DQ = \sum_{i=1}^{N} \alpha_i DQC_i \quad \text{where} \quad \begin{matrix} \forall \alpha_i : 0 \leq \alpha_i \leq 1 \\ \sum_{i=1}^{N} \alpha_i = 1 \end{matrix} \tag{1}$$

Moreover, realignments are very expensive operations in terms of engaged resources. Due to the complex and the time-consuming update procedures, data redundancy has a definite cost [6]. The greater the frequency with which data are captured and the larger the data set to be refreshed, the higher the cost [7]. In addition to the costs related to the synchronization frequency, it is also important to analyze the benefits regarding data quality. Thus, in order to find the most suitable frequency of synchronization it is important to consider and determine both technological and economics factors involved.

First of all, we analytically analyze the benefits of the improvement of the synchronization frequency on some data quality dimensions (i.e. availability and timeliness). An analysis of the trend of the two dimensions along the frequency of synchronization shows the trade-off between them (Fig. 1). As regards timeliness, it can be represented by an s-curve in which we can see that it will not benefit from a low frequency of synchronization because only the small portion of data associated will be positively affected while high increases of timeliness will occur when the frequency of synchronization raises so much to guarantee the updateness of a larger percentage of data. Finally, the curve presents small improvements of timeliness in correspondence to high frequencies of synchronizations, because they affect only a small portion of very high volatile data. On the contrary, availability has a trend that is reversely proportional to the increase in the frequency of synchronization.

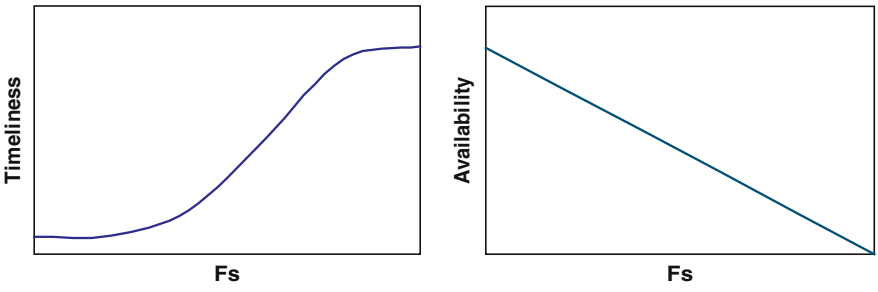


Fig. 1 Trend of timeliness and availability in relation with frequency of synchronization

Considering that data have two statuses, accessible or not accessible, a linear trend of availability can be assumed. The gradient of the straight line is the time in which a synchronization process is performed. Finally, the greater the frequency with which data is captured and the larger the data set to be refreshed, the higher the cost. It can be assumed that the cost tends to increase in respect of the synchronization frequency with an exponential trend.

In the following we now analyse the implications of these observations, and examine the synchronisation under a cost and benefit aspects. Considering (1) it is possible to calculate the aggregate data quality as the following:

$$DQ = \alpha_1 Availability(f_s) + \alpha_2 Timeliness(f_s) \tag{2}$$

As an example, let consider two scenarios that have different data usage requirements such as data warehouse systems and operational applications composed by distributed databases applications. The two systems have to satisfy different requirements. In a data warehouse environment, the application is used mainly for read operations and its main goal is providing information for supporting the decision process. Therefore, it can be assumed that the access time is relatively longer than the time spent for loading. In respect of the two considered dimensions in data warehouse systems, availability is more important than timeliness. The decisions usually extracted from the data warehouse have not a direct effect on the operational management and a low timeliness is tolerated despite a low availability. In an operational system the users instead prefer to have an accurate service rather than a rapid answer. Indeed, the incorrectness and the outdateness of information caused of a misalignment among different sources have more impact than a delay in the response time of the system. In this context we assume that the economical benefits deriving from data quality are proportional to the value assessed for the data quality dimensions. Along this assumption it is possible to compare cost and benefit and evaluate the total profit in the two considered scenarios. Analysis show that for data warehouse scenario (Fig. 2), the maximum value of profit, resulting

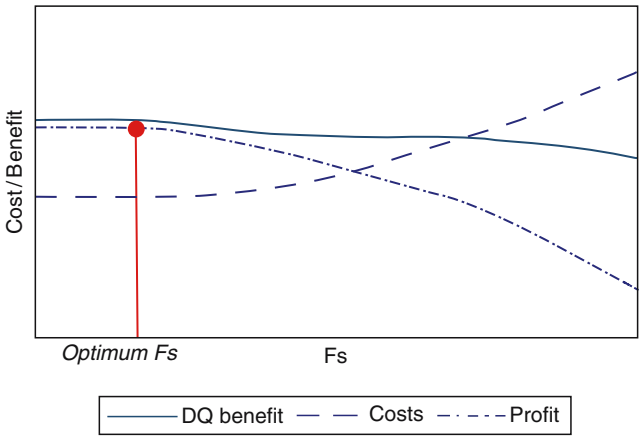


Fig. 2 Cost/benefit analysis in a data warehouse system

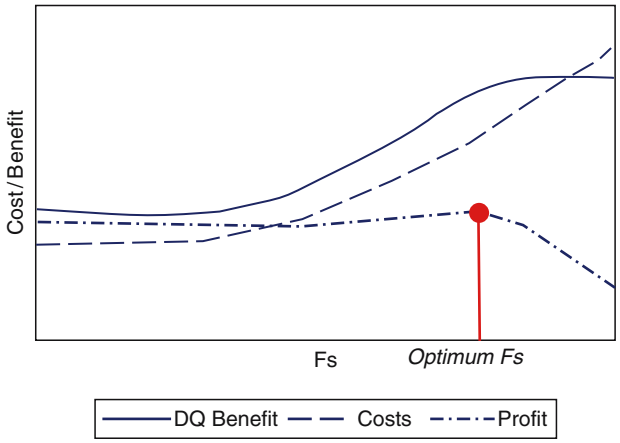


Fig. 3 Cost/benefit analysis in an operational system

from the subtraction of the synchronization costs from the data quality benefits, is achievable with a low value of synchronization frequency. This is explainable for the dominance of the availability dimension.

Conversely, in the operational system (Fig. 3), operational activities are crucial for the core business of the organization and the outdateness of information impacts on its correctness and completeness. The effects of the poor quality, if perceived by the users can be disastrous, in fact they, beside to increase operational costs, imply customer dissatisfactions that involve decrease of profitability. For this reasons in the assessment of data quality benefits more relevance is associated with timeliness despite of availability. Coherently, the maximum value of the profit is obtained in correspondence of higher values of synchronization frequency that are able to guarantee the presence of updated data in all the sources of the systems.

Note that the data quality benefit curves, represented in both figures, are determined using (1) (i.e. adding timeliness and availability as described in Fig. 1).

Conclusions

In literature as well as in practice, it is often assumed that in order to reach the maximum data quality and the best satisfaction of user requirements the implementation of online synchronization mechanisms is necessary. In our research we described data-redundant information systems and analyzed the dependencies between synchronization and data quality. The results of this paper show that the technical most suitable architectural solutions do not necessary result in best profitable and suitable approaches for the enterprise. In order to optimize the information system, the decision for appropriate architectural solutions has to follow a analysis of all benefits and costs. As we illustrated data quality requirements are dependent on

the application context and differing in various data quality criteria, which are often contradictory. The different requirements followed from the system's purpose impact solutions for data management in different ways. Exemplary we considered in section "The Data Quality Perspective" a data warehouse system and the results show a simple synchronization system characterized by a low frequency is able to guarantee the maximum gain and satisfy the quality requirements. In contrast for operational systems a higher synchronization frequency is suitable. Future work aims to extend the analysis to other data quality dimensions and to evaluate the results with an empirical study.

References

1. Pacitti, E. and Simon, E. (2000). Update propagation strategies to improve freshness in lazy master replicated databases. *VLDB Journal* 8 (3–4): 305–318
2. Orr, K. (1998). Data quality and systems theory. *Communications of the ACM* 41 (2): 66–71
3. Wand, Y. and Wang, R.Y. (1996). Anchoring data quality dimensions in ontological foundations. *Communication of the ACM* 39 (11): 86–95
4. Cappiello, C., Francalanci, C., and Pernici, B. (Winter 2003–2004). Time-related factors of data quality in multichannel information systems. *Journal of Management Information Systems*, 20 (3): 71–91
5. Jarke, M., Lenzerini, Vassiliou, Y., and Vassiliadis, P. (1999). *Fundamentals of Data Warehouses*. Springer, Berlin
6. Barbara, D. and Garcia-Molina, D. (1981). The cost of data replication. *In Proceedings of the Seventh Data Communications Symposium*, Mexico, pp. 193–198
7. Collins, K. (1999). Data: Evaluating value vs. cost. Tactical Guidelines, TG-08–3321. Gartner Group

The Impact of Functional Complexity on Open Source Maintenance Costs: An Exploratory Empirical Analysis

E. Capra and F. Merlo

Abstract It is well known that software complexity affects the maintenance costs of proprietary software. In the Open Source (OS) context, the sharing of development and maintenance effort among developers is a fundamental tenet, which can be thought as a driver to reduce the impact of complexity on maintenance costs. However, complexity is a structural property of code, which is not quantitatively accounted for in traditional cost models. We introduce the concept of functional complexity, which weights the well-established cyclomatic complexity metric to the number of interactive functional elements that an application provides to users. The goal of this paper is to analyze how Open Source maintenance costs are affected by functional complexity: we posit that costs are influenced by higher levels of functional complexity, and traditional cost models, like CoCoMo, do not properly take into account the impact of functional complexity on maintenance costs. Analyses are based on quality, complexity and cost data collected for 906 OS application versions.

Introduction

Authors in the software economics field concur that software maintenance accounts for the major part of the entire software life-cycle costs. The cost efficiency of maintenance interventions is affected by many factors: a fundamental cost driver is the complexity of code. Many models of software cost estimation have historically been focused on the evaluation of development costs, typically not considering complexity metrics. As suggested by a study on commercial software by Banker et al. [1], high levels of software complexity account for approximately 25% of maintenance costs or more than 17% of total life-cycle costs. This is challenged by Open Source

Politecnico di Milano, Dipartimento di Elettronica e Informazione, Milano, Italy, capra@elet.polimi.it, merlo@elet.polimi.it

(OS) development and maintenance practices, since one of the fundamental tenets of Open Source is the sharing of effort among developers.

This paper addresses this issue by analyzing the impact of software functional complexity on maintenance costs in the OS context. The goal is to test whether OS maintenance costs are affected by functional complexity, or if the cost sharing enabled by OS practices allows economically efficient maintenance interventions. Since complexity is a structural property of code, unrelated with quality aspects of code, we hypothesize that even if OS software addresses high quality standards [2], the impact on maintenance costs is harder to reduce, and cannot be easily assessed by traditional cost evaluation models like CoCoMo.

The measurement of software quality is traditionally based upon complexity and design metrics. Software quality has to be intended as a complex property, composed of many different aspects. In particular, with the proposal and the diffusion of the object oriented programming paradigm, the concept of quality has been tightly tied to the notions of coupling and cohesion (see [3, 4]). More recently, some metrics suites have been proposed to evaluate the quality of design of an object oriented software, like the ones by Chidamber and Kemerer [5] and Brito e Abreu [6]; these works have been subjected to lively debates and in-depth analysis by the academic community, which have proved the usefulness of the metrics for example as indicators of fault-proneness of the software [7].

Several models and techniques of cost estimation have been proposed (e.g., [8, 9]), as well as comprehensive evaluations (e.g. Kemerer [10] and Briand et al. [11]). The literature makes a distinction between the initial development cost and the cost of subsequent maintenance interventions. These have been empirically found to account for about 75% of the total development cost of an application over the entire application's life cycle [9]. The first and today still most used cost model, called Constructive Cost Model (CoCoMo), has been defined by Boehm in the early 1980s [2], and successively enhanced and evolved. CoCoMo provides a framework to calculate initial development costs based on an estimate of the time and effort (man months) required to develop a target number of lines of code (SLOC) or Function Points (FP).

This paper is organized as follows. Section "Research Method" presents our research method and hypotheses. Section "Experimental Results" discusses and provides a statistical verification of the hypotheses, while section "Discussion and Conclusions" presents our results and future work.

Research Method

The evaluation of software properties has been carried out through the measurement of a set of metrics that is comprised of 18 metrics intended to asses various characteristics at different levels of granularity.

First, we have described applications from a general point of view: to achieve this, we have selected a set of "classic" metrics intended to give information about the size of the applications (like source lines of code, number of methods and

number of interactive GUI functionalities). In addition, we have characterized applications from the point of view of their inherent complexity through McCabe's cyclomatic complexity [13].

We introduce the concept of functional complexity, which is defined as follows. Given a system S of cyclomatic complexity CC_S, composed by its set of objects $O = \{O_1, \ldots, O_n\}$ and defined for each object O_i its set of methods $M_i = \{M_1^i, \ldots, M_n^i\}$, we define the average functional complexity $FC(S)$ for system S as:

$$FC(S) = \frac{CC_S \cdot \sum_{O_i \varepsilon O} |M_i|}{FUN(S)} \tag{1}$$

where $FUN(S)$ is the number of functionalities of system S. The intuitive meaning of this metric is to assess how complex is an application, looking at it from the point of view of the number of functionalities it provides to the users. We chose to relate the complexity measurement to the functionalities *FUN* because empirical evidence from our analyses showed that *FUN* is uncorrelated with any other metric that we have considered: thus, it can be considered as a good indicator of something that is not dependent from any other characteristic of an application, like dimensions or structural properties of code or design.

To support the evaluation of applications' design properties, we have included in our metric set two of the most used suites of object oriented design metrics: in particular, the MOOD metric set [6] for evaluations at system level, and the Chidamber and Kemerer metrics suite [8] for measurements at class level.

The maintenance effort has been estimated considering the days elapsed between the release of subsequent versions, weighted with the number of active developers of each project; considering the i-th version v_i^k of application k, the maintenance effort for the subsequent version j is:

$$ME(j) = [date(v_j^k) - date(v_i^k)] \cdot a_k \cdot EAF \tag{2}$$

where a_k is the number of active developers of application k (for the purposes of this study, a_k has been set equal to the number of project administrators as indicated on each project home page on SourceForge.net), and *EAF* is an effort adjustment factor which has been derived by an empirical survey of 87 active developers of the SourceForge.net community. In particular, we have asked each developer which fraction of his/her time is spent for development activities related to the OS project he/she is involved into: results showed that a project admin works an average of 8.09 h per week, while a developer 8.62 h per week. The adjustment factor thus allows to address the fact that OS developers may not work full time and that they might be involved into more that one project at a time.

Maintenance costs have been estimated using the CoCoMo model [14] in its basic form. Model parameters have been weighted for the evaluation of organic projects.

Data Source and Analysis Methodology

The data set used for this study has been derived from direct measurements on the source code of a sample of OS community applications taken from the

SourceForge.net repository. We selected our data sample to preserve the heterogeneity of the classification domains of SourceForge.net, in order to snapshot a significant subset of applications. Since mining on line repositories such as SourceForge.net can lead to controversial results because of the varying quality of available data [15], applications have been selected according to the following criteria:

- *Project Maturity*: beta status or higher. Less mature applications have been excluded because of their instability and low significance
- *Version History*: at least five versions released
- *Domain*: selected applications are uniformly distributed across the SourceForge.net domain hierarchy.

The initial set of applications has been automatically cleaned by removing all those applications which resulted not consistent with our quality requirements, leading to dataset DS_1, which has been manually analyzed to avoid inconsistencies among different versions of the same application, non-related source code archives, or damaged data archives: this lead to the final dataset, named DS_2.

Source code has been analyzed with a tool developed ad-hoc. Our tool provides data on all the metrics used, performing static analyses of Java source code. The static analysis engine is based on the Spoon compiler [16], which provides the user with a representation of the Java AST in a metamodel that can be used for program processing.

The perspective adopted by our tool is explicitly evolutionary: given an application, metrics measurements are carried out on each version, computing not only the punctual values but also the variations between each version and the preceding one.

Research Hypotheses

Software quality can be improved through periodic refactoring interventions (cf. [17]). By restoring quality, refactorings reduce entropy and, hence, maintenance costs. Although, as noted by Fowler (cf. [18]), that refactorings are typically performed to (a) increase software quality and (b) integrate functionalities developed in different versions of the same application. Inherent complexity of source code should not consequently be affected by refactoring interventions, since there is a rather sharp point past which it is not possible to trade away features for simplicity, because "the plane has to stay in the air" (cf. [19]). This is summarized by our first research hypothesis:

> H1: In an OS context, functional complexity and refactoring frequency are unrelated variables; that is, functional complexity is an inherent characteristic of source code, which cannot be affected by improvements of code quality attributes.

Given that the functional complexity is not affected by refactoring interventions, since it is a measure of the inherent complexity of source code, we posit that applications with higher levels of functional complexity should require a greater effort

for maintenance interventions. This is due to the fact that in that class of applications code understanding and modification should be influenced and made harder by the high intrinsic complexity of the code itself. From this considerations follows our second research hypothesis:

> H2: In an OS context, the maintenance effort of applications with a greater functional complexity is higher that the maintenance effort of applications with a lower functional complexity.

As a consequence, functional complexity can be considered as a proxy of the maintenance effort, which should be taken into account when estimating maintenance costs. Nevertheless, cost estimation models often consider just the dimensions of the application that is undergoing the maintenance activity, since they are size based. This is a misleading simplification, and gives significance to our last research hypothesis:

> H3: Traditional cost models (such as CoCoMo) fail to distinguish between code dimensions and functional complexity, since they are simplistically size-based. More- over, eventual parameters to account for complexity are generally too generic and not related with code and/or design properties.

Experimental Results

To correctly set up hypotheses verification tests, we proceeded to verify if data series related to the two application clusters were normally distributed. Since the Jarque–Bera normality test showed that data samples are not normally distributed, we used the Wilcoxon–Mann–Whitney rank sum test to check hypotheses H2 and H3.

Hypothesis H1 has been verified by testing various kinds of correlations between refactoring frequency and functional complexity. Data series of refactoring frequency and functional complexity values have been studied by means of a regression analysis. The evaluation has been performed through the analysis of the coefficient of determination R2 for each kind of relation. None of the considered relations can be assumed to persist between refactoring frequency and functional complexity values, since R2 values are all below 0.03, which is an extremely low value. These results support H1, confirming that in an OS context the functional complexity of a given system is not correlated with the frequency of refactoring interventions.

Hypothesis H2 has been tested by dividing applications into two clusters, with functional complexity above (cluster FC_{HI}) and below (cluster FC_{LO}) the median value, respectively. The Wilcoxon-Mann-Witney test has been set up on the null hypothesis h_0: $F(ME_{LO}) = F(ME_{HI})$ against the alternative hypotheses h_1: $F(ME_{HI}) \leq F(ME_{LO})$, where $F(X)$ is the probability distribution function; the test has been executed on the data related to all the versions of the applications: the WMW test suggested to reject the null hypothesis with a p-value of 0, confirming hypothesis H2.

Hypothesis H3 is verified by comparing the probability distribution functions of samples related to the estimated CoCoMo costs for the applications in cluster FC_{LO} and cluster FC_{HI}, respectively named $F(Effort_{LO})$ and $F(Effort_{HI})$. The null hypothesis h_0: $F(Effort_{LO}) = F(Effort_{HI})$ has thus been checked against the alternative hypothesis h_1: $F(Effort_{HI}) \neq F(Effort_{LO})$. In this case, the WMW test suggested to accept the null hypothesis with a significance level of 97%: that is, the probability distribution functions of the given samples are equal. This confirms hypothesis H3, since if the probability distributions functions are equal, their means are equal too.

Discussion and Conclusions

Results indicate that complexity is an inherent property of source code, and can be hardly influenced by quality oriented interventions such as refactorings. This is motivated by the fact that software inherent complexity is strictly tied with the fulfillment of functional requirements, and cannot be reduced or simplified beyond a certain point. Results prove this statement, showing that even in a well recognized high quality context, such as the OS one, complexity of code do affect maintenance costs: our estimates show that high functional complexity levels account for an increase of 38% of maintenance effort.

Further, results show that traditional cost models fail to model the impact of complexity on cost evaluations. CoCoMo estimates, which have been tailored to reflect the properties of the applications of our sample, account just for 7% of variation of maintenance costs.

Although these considerations are based on a preliminary empirical analysis, some valuable results can be stated: given that complexity considerably increases maintenance costs even in a high software quality context like the OS one, a precise evaluation of complexity should not be neglected since the aggregate cost for contexts like the industrial one is like to be substantial. Future work is focused on defining the causal relationships between quality metrics by means of regression analyses: this will allow us to better describe which are the driving quality dimensions affecting maintenance costs.

References

1. Banker, R., Datar, S., Kemerer, C., and Zweig, D. (1993). Software complexity and maintenance costs. *Comm. ACM* vol. 36, no. 11, pp. 81–94
2. Paulson, J.W., Succi, G., and Eberlein, A. (2004). An empirical study of open-source and closed-source software products. *IEEE Trans. Software Eng*. vol. 30, no. 4, pp. 246–256
3. Emerson, T.J. (1984). Program testing, path coverage and the cohesion metric. In: Proc. COMPSAC84, pp. 421–431
4. Longworth, H.D., Ottenstein, L.M., and Smith, M.R. (1986). The relationship between program complexity and slice complexity during debugging tasks. In: Proc. COMPSAC86, pp. 383–389

5. Chidamber, S. and Kemerer, C. (1994). A metrics suite for object oriented design. *IEEE Trans. Software Eng*. vol. 20, pp. 476–493
6. Brito e Abreu, F. (1995). The MOOD metrics set. In: Proc. ECOOP Workshop on Metrics
7. Gyimothy, T., Ferenc, R., and Siket, I. (2005). Empirical validation of object-oriented metrics on open source software for fault prediction. *IEEE Trans. Software Eng*. vol. 31, pp. 897–910
8. Zhao, Y., Kuan Tan, H.B., and Zhang, W. (2003). Software cost estimation through conceptual requirement. *Proc. Int. Conf. Quality Software* vol. 1, pp. 141–144
9. Boehm, B., Brown, A.W., Madacy, R., and Yang, Y. (2004). A software product line life cycle cost estimation model. *Proc. Int. Symp. Empirical Software Eng*. vol. 1, pp. 156–164
10. Kemerer, C.F. (1987). An empirical validation of software cost estimation models. *Comm. ACM* vol. 30, no. 5, pp. 416–430
11. Briand, L.C., El Emam, K., Surmann, D., Wiezczorek, I., and Maxwell, K.D. (1999). An assessment and comparison of common software cost estimation modeling techniques. *Proc. Int. Conf. Software Eng*. vol. 1, pp. 313–323
12. Cocomo official website (http://sunset.usc.edu/research/cocomoii/index.html)
13. McCabe, T.J. (1976). A complexity measure. In: Proc. Int. Conf. Software Engineering, vol. 1, p. 407
14. Boehm, B. (1981). Software Engineering Economics. Prentice-Hall, NJ
15. Howison, J. and Crowston, K. (2004). The perils and pitfalls of mining SourceForge. In: Proc. Int. Workshop Mining Software Repositories, pp. 7–12
16. Pawlak, R. and Spoon (2005). Annotation-driven program transformation – the AOP case. In: Proc. Workshop on Aspect-Orientation for Middleware Development, vol. 1
17. Chan, T., Chung, S., and Ho, T. (1996). An economic model to estimate software rewriting and replacement times. *IEEE Trans. Software Eng*. vol. 22, no. 8, pp. 580–598
18. Fowler, M., Beck, K., Brant, J., Opdyke, W., and Roberts, D. (2001). Refactoring: Improving the Design of Existing Code. Addison Wesley, Reading, MA
19. Raymond, E.S. (2004). The Art of Unix Programming. Addison Wesley, Reading, MA

Evaluation of the Cost Advantage of Application and Context Aware Networking

P. Giacomazzi and A. Poli

Abstract Application and context aware infrastructures involve directly the network in the execution of application-layer tasks through special devices, referred to as cards, placed in network nodes. The sharp separation of distributed applications and network is smoothed and, by performing part of the application or middleware inside the network, it is possible to obtain economic benefits mainly provided by a better optimization of the whole ICT infrastructure. This higher optimization is allowed by the additional degree of freedom of placing cards in network nodes and of assigning application-layer processing to such cards. In this paper, we summarize an optimization algorithm capable of minimizing the total cost of the entire ICT infrastructure, given a target performance objective defined as the average end-to-end delay for the completion of the distributed application tasks, and we focus on two sample applications: caching and protocol translation. The joint optimization of computing and communication requirements is one of the most innovative contributions of this paper, as in the literature hardware and network components are optimized separately.

Introduction

Application and context aware networking, also referred to as intelligent networking, is an emerging technology enabling an effective and efficient interaction among applications, by involving the network in the execution of application-layer tasks. The hardware implementing intelligent networking functions is a card that can be installed on routers [1, 2]. Application and context aware networking stems from urgent needs for integrating numerous applications independently designed, developed, and deployed and the constant search for a reduction of the corresponding cost of the ICT infrastructure, including both network and hardware components.

Politecnico di Milano, Dipartimento di Elettronica e Informazione, Milano, Italy,
giacomaz@elet.polimi.it, poli@elet.polimi.it

An advantage enabled by intelligent networks is cost optimization. By allowing network devices to perform application-related functions, the design of the entire hardware and network infrastructure acquires an additional design option. This increases the complexity of design, but offers the opportunity to improve the cost-performance ratio of the system. In this respect, the problem of the optimal allocation of cards is still open, as a model that drives to a solution accounting for both cost and performance gains [3] is still lacking.

In our work we want to explore and quantify the economical advantages offered by application and context aware networking. We focus on a limited set of intelligent network services, namely *caching* and *protocol translation*, and calculate the cost reduction enabled by the intelligent network.

In order to evaluate the benefits of application and context aware networking a full model for the optimal design of information technology infrastructures, comprised of hardware and network components, is needed.

An overall methodology for combining hardware and network design in a single cost-minimization problem for multi-site computer systems has been recently proposed by [4]. However, the optimization methodology lacks an accurate analysis of performance parameters, as the sizing of infrastructural devices is based on capacity thresholds without estimating response time.

The cost model of our methodology is drawn from [4] and has been associated with a performance model in [5]. This work further extends the model to include application and context aware network devices.

Overall, we consider a multi-site scenario and address the following design choices: (a) server farm localization (b) allocation of server applications on shared server farms (c) allocation of cards (d) identification of the actual technological resources, i.e. the sizing of devices.

The Optimization Problem

In this section, the general model of the considered infrastructure is described.

Technology Requirements

Requirements are formalized identifying the following attributes:

- Sites, distance among sites, and available network connections among sites
- Server applications, and their CPU and disk time usage, RAM and disk space usage, request and response messages size, caching application and its hit rate probabilities, and protocol translation application
- Caching applications, and their CPU and disk time usage
- Protocol translation applications, and their CPU and disk time usage, and RAM and disk space usage

- User groups, and their user number, site, used applications, frequency of requests, and response time requirements

Technology Resources

The computing requirements of the reference organization can be satisfied by means of the following hardware resources:

- Link types, described by cost, minimum distance, maximum distance, and capacity
- Router types, described by cost, service rate, maximum backplane service rate, classifier coefficient, and routing coefficient
- Server types, described by cost, RAM size, disk space, CPU performance benchmark, and disk performance benchmark
- Card types described by cost, CPU performance benchmark, and disk performance benchmark
- Server farms, made up of a set of servers of the same type
- Routers, i.e. instances of router types, assigned to sites
- Links, i.e. instances of link types, assigned to each site pair with an available connection
- Cards, i.e. instances of card types

The Optimization Model

Decision Variables

Optimization alternatives are represented by a set of architectural decision variables, identifying:

- The allocation of applications to server farms
- The allocation of server farms to sites
- The allocation of cards on routers
- The association of a type to each device

Response Time

For each user group-application pair, direct and reverse routing paths from the site of the user group to the site of the server farm where the application is allocated are identified. The devices met along the paths are considered in order to compute device load.

The response time experienced by the requests from a user group to an application is given by the sum of the response times of all the traversed devices. Application requests can be served by the cards met along the path, decreasing the load of links, routers, and servers. For each different type of device a network of multiple class M/M/1 queues is used.

Objective Function and Constraints

The objective function to be minimized is the total cost, *TC*, of the technology resources (servers, links, routers, and cards) selected to satisfy requirements over a given time horizon. The solution must comply with a set of constrains, e.g. each server application is allocated on one server farm, each server farm is allocated on one site, etc.

Cost Minimization Algorithm

The cost minimization algorithm aims at identifying the minimum-cost solution that satisfies technology requirements with corresponding technology resources. The algorithm is based on the tabu-search (TS) approach [6].

An initial solution is identified first. Then, the neighborhood of solutions is explored by executing four types of moves: *application displacement*, *server farm displacement*, *card insertion*, and *card removal*. The execution of a move changes the configuration of decision variables. This configuration is an input to the *device sizing* phase of the cost minimization algorithm. Tabu moves are performed to reduce *TC*. The device sizing phase is re-executed after each *tabu move*.

The *device sizing* phase identifies a set of technology resources satisfying all requirements, and calculates the corresponding total cost *TC*. Sizing is performed in two steps: a first sizing followed by a sequence of upgrades and downgrades.

The first sizing assigns to each device a type in such a way that the maximum load of all queues is lower than 60%. An upgrade replaces the current type of a device with a more costly type. The algorithm performs a series of upgrades, until a solution satisfying all delay constraints is reached. Then, configuration space is explored by means of a series of downgrades and upgrades in order to identify the minimum-cost set of devices. A downgrade replaces the current type of a device with a less costly type, bringing to a solution with a lower total cost. The best solution found is selected as the output of the device sizing phase.

Results

This section provides empirical evidence of the cost savings granted by cards supporting *protocol translation* and *caching* services. Empirical verifications have been

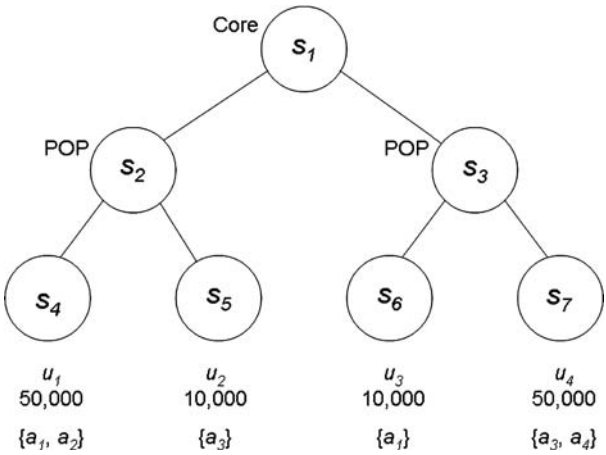


Fig. 1 Topology, user groups and applications

supported by a prototype tool that implements the cost minimization algorithm. The tool includes a database of commercial technological resources and related cost data.

Scenario Description

In this paper, a single case study with 120,000 users distributed in a tree-topology network is presented (Fig. 1). The parameters of the applications required by users are shown in Table 1. CPU and disk time are all referred to reference server "HP UX11i 0.75GHz PA-8700 4GB".

Optimization Results

The cost minimization algorithm is applied varying response time requirements. Analyses are performed by comparing the costs of optimization solutions, obtained with and without cards, respectively. Costs are minimized over a 3 year period.

Total cost *TC* is shown in Fig. 2. Costs are significantly higher when delay constraints are tighter. *TC* is three times higher as maximum response time decreases from 0.34 to 0.18 s. Average percent savings, when application and context aware services are available, are roughly equal to 20%.

Figure 3 shows the distribution of costs across different technology resources, when response time constraint is 0.2 s. Most of the cost is associated with links and server farms. Most cost savings are gained by reducing server farm cost by means of the application and context aware services.

Table 1 Application parameters

	a_1	a_2	a_3	a_4	a_1^C	a_1^{PT}	a_2^C	a_2^{PT}
Request size	16,384 bit	32,768 bit	16,384 bit	40,960 bit	–	–	–	–
Response size	327,680 bit	81,920 bit	409,600 bit	81,920 bit	–	–	–	–
CPU time	0.50 s	0.75 s	0.50 s	0.75 s	0.04 s	0.15 s	0.04 s	0.15 s
Disk time	0.075 s	0.20 s	0.075 s	0.20 s	0.02 s	0.04 s	0.02 s	0.04 s
RAM space	200 MB	500 MB	200 MB	500 MB	–	300 MB	–	500 MB
Disk space	20,000 MB	30,000 MB	20,000 MB	30,000 MB	–	5,000 MB	–	5,000 MB
Caching appl.	a_1^C	–	a_2^C	–	–	–	–	–
Hit rate lev.1	0.375	–	0.375	–	–	–	–	–
Hit rate lev.2	0.175	–	0.175	–	–	–	–	–
Hit rate lev.3	0.075	–	0.075	–	–	–	–	–
Prot. transl. appl.	–	a_1^{PT}	–	a_2^{PT}	–	–	–	–

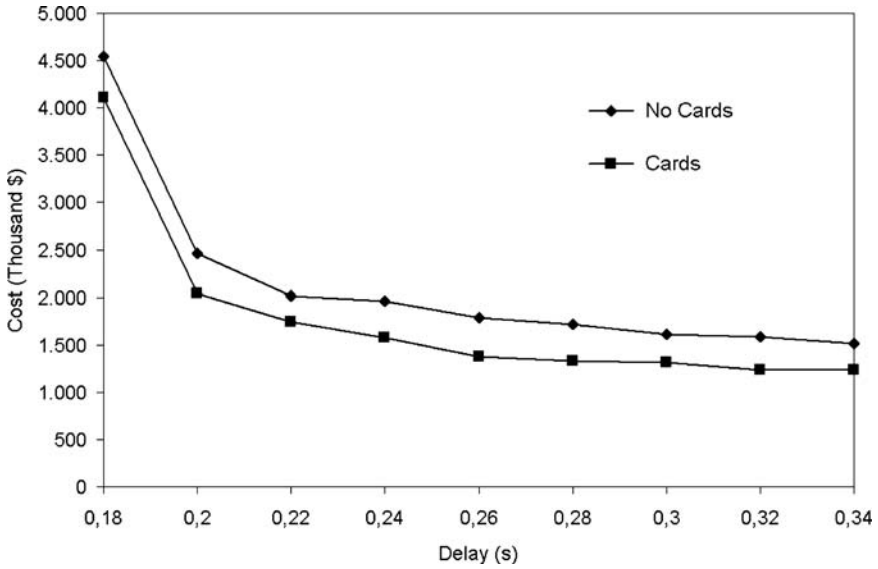


Fig. 2 Total cost

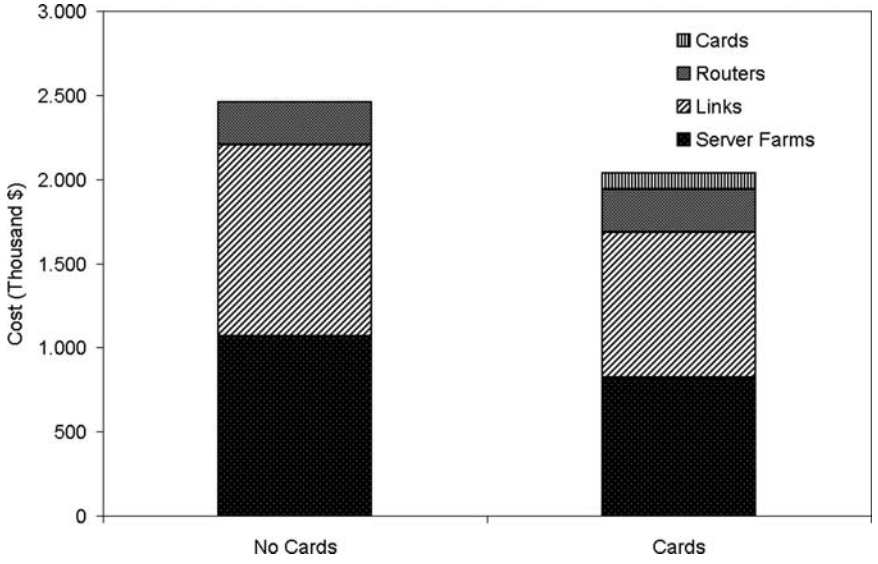


Fig. 3 Percent distribution of costs across different technology resources

Conclusions

We have proposed an optimization algorithm able to jointly minimize the total cost of hardware and communication given a target performance requirement consisting in the total average end-to-end delay for the execution of the distributed application-layer task. Our algorithm is set in the frame of the innovative application oriented networking, where application modules can be executed by network nodes by placing special application cards in network routers. This technical choice allows several additional degrees of freedom in the optimization process, mainly consisting in where application cards are installed and in which applications are assigned to which cards. We have implemented our algorithm in a software tool with a large database of real performance and cost data of hardware and network components. We have found that the economic advantage that we can obtain with the adoption of the application-oriented networking paradigm is on the order of 20%.

References

1. Cisco (2007) Cisco catalyst 6500 series application-oriented networking module. Cisco Systems data sheet, http://www.cisco.com/en/US/products/ps6438/products_data_sheet0900aecd802c1fe9.html. Cited 1 September 2007
2. Cisco (2007) Cisco 2600/2800/3700/3800 series AON module. http://www.cisco.com/en/US/products/ps6449/index.html. Cited 1 September 2007
3. Sivasubramanian, S., Szymaniak, M., Pierre, G., and Van Steen, M. (2004) Replication for web hosting system. ACM Comput Surv 36(3): 291–334
4. Ardagna, D., Francalanci, C., and Trubian, M. (2008) Joint optimization of hardware and network costs for distributed computer systems. IEEE Trans Syst, Man, and Cybern 38(2): 470–484
5. Amati, A., Francalanci, C., and Giacomazzi P. (2006) The cost impact of application and context aware networks. Quaderni Fondazione Silvio Tronchetti Provera, Egea
6. Glover, F. and Laguna, M. (1997) *Tabu Search*. Kluwer, Norwell

Best Practices for the Innovative Chief Information Officer

G. Motta[1] **and P. Roveri**[2]

Abstract The paper illustrates a set of best practices used by successful IT managers to manage IT enabled business innovation. In IT intensive business a key point is to build innovative IT solutions for business innovation sometimes without formal requirements. Based on a panel of the largest and most innovative corporations in Telecommunications, Energy, Utilities and Media we sketch out some best practices to solve this innovation dilemma. Also we discuss best practices for project delivery and operations management, that make a framework of IT management for companies with an aggressive IT strategy. The resulting IT management framework defines a new profile for an innovative, proactive CIO profession.

Introduction

A CIO may play a variety of roles. He can be a retiring old timer, who operates in a reactive way, like an internal supplier, with low efficiency. He may be a fan of the EBIT (Earning Before Interest an Taxes), be very efficient, and comply with the best standards such as ITIL. Of course, these CIOs will give only a little contribution to business innovation and competitiveness. However, a CIO can interpret his role proactively and focus on business innovation. He may try to be an innovation champion, disregarding efficiency; but hardly he can last a reasonable time. But can the CIO be innovative and efficient? This is precisely the scope of this paper that sketches best practices of a proactive (and wise) CIO.

CIO and Business Service Chain

A proactive CIO enables and innovate business service chains. A business service chain is a business process that delivers services and/or products to customers e.g.

[1]Università di Pavia, Pavia, Italy, gianmario.motta@unipv.it
[2]Business Integration Partners, Italy, paolo.roveri@mail-bip.com

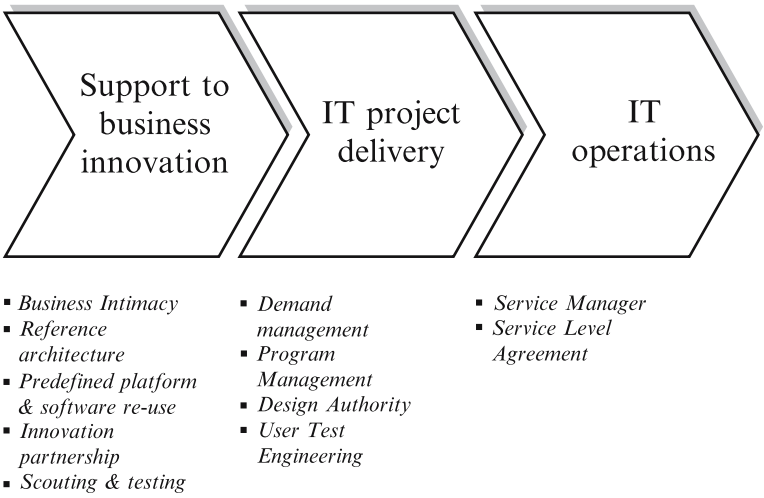


Fig. 1 IT service chain and related best practices

user activation in a telecommunication operator or a power distributor, money transfer in a bank, clinic test in healthcare.

Undoubtedly, effective and efficient business service chains are a competitive factor. Customers choose bank with rapid procedures and disregard banks with ineffective and slow procedures. Even if IT per se does not matter in business [1, 2], IT supported chains do matter, since they enable corporations to do business. In an offensive IT strategy [3], with IT playing a key role in business innovation and performance, the CIO is a critical factor.[1] In these situations, the CIO not only manages resources but also co-designs business service chains.

In order to serve business service chains, the CIO should in turn develop its IT service chains for (a) Business Innovation (b) Project delivery (c) Operations (Fig. 1).

For each of these three IT service chains we propose a set of best practices that were identified in a research on a panel of companies in Utilities, Energy and Telecommunications.

The research methodology has been based on an interview (two hours) with the CIO, based on a questionnaire.[2] Minutes have been revised by the CIOs interviewed.

[1] The issue of IT management has been already studied in early Seventies. For instance, IT management systems are a key element of Nolan's Stage Theory [4] where IT organization and IT management are considered as IT growth factors in organizations. An overall model of the Information Systems function that separates the three functions of planning (=innovation), development (=project delivery) and operations is described by Dave Norton [5]. A discussion of these and other overall IT management models is given in [6]. Today the most comprehensive framework on the IT service management is the Information Technology Infrastructure Library (ITIL).

[2] The questionnaire contained a list of CIO issues that the authors discussed with the CIO face to face. The list was used only to have a platform for identifying the CIO's strategy in the organization. The CIO was free to add his or her own points.

A first report was published in Italian [7] and a summary, integrated by three more corporations (H3G, Fastweb, Edison) was given in a paper on an Italian journal [8]. In the following paragraphs we summarize some results of the research.

Best Practices for IT Enabled Business Innovation

Business Intimacy

As a CIO stated "You cannot ask CRM specs of a product that has not yet been launched!". Emerging strategic needs should be captured by interpersonal relations with functions that drive business innovation, such as Marketing in Telecommunications, and by attending strategic committees. Business intimacy is the ability of perceiving emerging business needs and of defining their IT implications. In start-ups such as H3G and Fastweb, business intimacy is also enabled by a strong team feeling, where the CIO is regarded not as a supplier but as a colleague who will enable business.

Reference Architecture

Defining a reference architecture of IT systems is a common practice in the panel. A map of systems makes easier conciliating top down projects for business innovation and bottom up initiatives from functional management that tune systems to changing business needs. The reference architecture also includes a map of business processes, that allows to compare current and desired IT coverage; it provides a structured scenario for priority decisions, since managers can immediately visualize the impact of a project.

Reference architecture are numerous in the sample. In energy industry, under the pressure of deregulation, corporations have developed master plans and/or defined a formal reference architecture that is updated annually and/or complex strategic IT projects in telecommunications, architecture can be a preliminary activity, that provides the background needed to discuss IT or a continuing activity, that is part of the business innovation itself.

Scouting and Testing

Scouting and testing helps to select innovative technologies. Actually, an innovative corporation cannot rely on external experts and ad hoc research studies. Actually, IT department cannot afford a R&D function even in the most innovative corporations. Therefore, some corporations create small group of experts, that scan the market and/or cooperate with vendors and/or certify themselves on critical technologies

and/or test new solutions. Internal experts enable the CIO to screen options and find the best combination of solutions.

Cooperation and Partnership with Vendors

Generally relations with software vendors are considered as strategic. ERP, CRM and Billing platforms are long term decisions that cannot be easily changed. But innovative companies are less supported by standard platforms. Some companies, such as Vodafone, H3G, TIM, are considered test customers by vendors. To reduce innovation costs, some innovative corporations are partnering with vendors. The vendor develops innovative solutions for the corporation and retains the right of selling the new solution. Therefore followers might eventually pay software that has been almost free for leaders.

Reusable Platforms

Time to market is a critical innovation factor. But if the product is new and therefore you cannot know the process, how can you design IT systems? To fasten time to market some corporations re-use software, by extrapolating from existing applications "draft applications", that are adjusted to serve a new market proposition – in other words, a new system for the new product X puts together billing of product A plus the order processing of product B plus the service delivery of product C.

As a CIO said "When I hear a new product is coming up, I figure out with the guys of Marketing how the process could be and we prepare a package that could serve the new business. When we come back to Marketing and they see the package, they usually say, well it is not what we would love, but it might work. So we start to refine and come up with a first release. Modifying something already implemented is faster than implementing from scratch."

Project Delivery: The Governance Issue

Project delivery is a complex IT service chain that collects systems requests and releases software. The key question is what best practices of organization and governance are. From the research we found some points:

- Systems Engineering, that contains analysis of IT needs, design of systems and management of projects, separated from Systems & Software Factory, that contains IT implementation
- Development in Systems Engineering of core competences, each focused on a specific phase of the project life cycle, namely Demand Management, Design Authority, Program Management, User Test Engineering

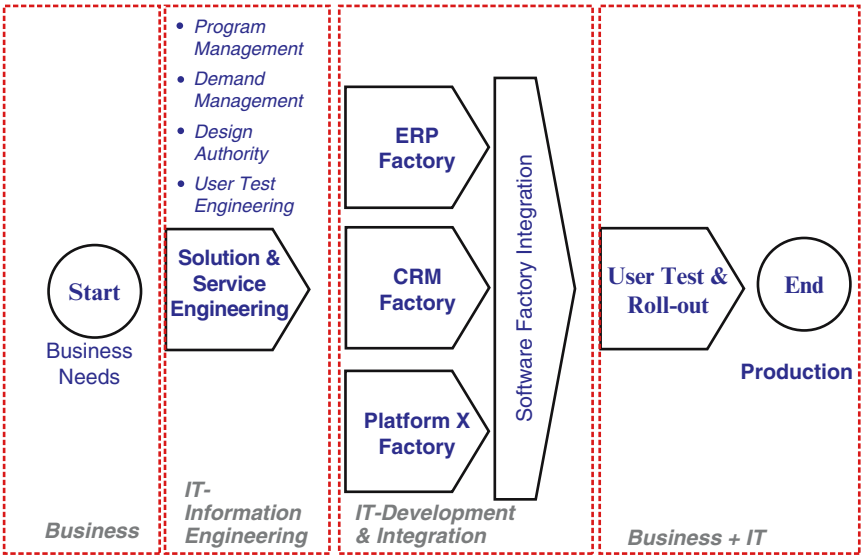


Fig. 2 Best practices of project delivery

- Development of multidisciplinary Factories, each one being responsible of implementation and maintenance of a given domain of application software and/or integration middleware

These points deserve some comments. The separation between Engineering and Factory reflects a strategic concept of corporate IT, where the IT value doe not arise from implementation skills but from designing systems that fit specific business processes. Therefore, factories but not engineering can be outsourced. An overall framework of project delivery is in Fig. 2, and subsequent paragraphs discuss each point.

Demand Management

Demand managers aggregate and coordinate the needs of users on existing systems, and, also, balance them against the available budget, negotiating priorities with business functions and costs with IT; actually, demand managers know business processes and have the competence to identify IT initiatives. The demand manager is a bottom-up complement to the strategic, top-down IT innovation, that we have discussed earlier.

Design Authority

In order to maintain a consistent IT architecture over time, a team is appointed to define and govern it. The design authority publishes architecture design, defines

standard and horizontal tools e.g. for the application integration. These competences and related processes are in almost all the panel.

Program Management

An innovative IT project typically includes (a) organizational initiatives as business process design, organizational development and change management, (b) application software initiatives, such as software customization and development, (c) technological initiatives such as application integration and collaboration, network and processing architecture design. Hence an integrated and formal management of the overall program is needed. Not surprisingly, program management is more developed in corporations that have successfully implemented large innovative projects.

User Test Engineering

An internal team for user test is a natural counterpart of implementation factory. The team tests applications on the actual business process, thus controlling not only if the software is correct bur also if it actually can work with the actual process. Surprisingly, a team of user test engineering is not frequent in the sample.

Systems Operations

The governance of IT operations is critical not only to assure dependability, response time and alike performances and also for the ability of responding to new or modified needs of customers. Best practices include the service manager and a comprehensive approach to service agreement.

A service manager is responsible of (a) the service level (b) the correct evolution of IT applications in front of business changes. This role, similar to the case manager described by [9], reflects a process oriented organization, where the IT organization is also structured by customer. With the service manager, the internal customer has an overall reference point for the computerized service chain, to which an overall reference for the analysis of needs corresponds, namely the demand manager.

The Service Level Agreement (SLA) is typical in corporations that outsource IT services. Its purpose is to integrate financial factors with qualitative factors that drive the value of the performance given by the service supplier. These factors include quality indicators, such as availability and error rate, and service quality, such as response time and rate of perfect orders. Measuring performances is useful if payments to the supplier are related to the measured performance level and if the actual

performances are periodically reviewed with the supplier in order to continuously improve the service.

Conclusions: Toward a Proactive IT Governance

The IT governance framework we have sketched proposes a CIO profile for innovative corporations, where:

- The innovative CIO reports to the CEO in all the corporations with an offensive strategy and is very close to a general management position; this proximity is confirmed by the strong relationship between CIO and business top management we have found in most companies.
- The CIO has a lower role in those companies where IT is less important and a defensive and conservative strategy is in place; in these cases, the CIO is often reporting to controller.
- The innovative CIO has not a technological and defensive vision but he believes IT organization should provide services and have a pragmatic approach to the business needs.
- The CIO promotes the development of a wide range of IT professions, that are business oriented and have the purpose to assure an effective and efficient governance along the entire systems life cycle.

The innovative CIO acts trough a governance framework. The framework includes the three areas f business innovation, project delivery, operations governance. Of course, these areas are not equally important to all the companies. The relative importance can tuned by considering the business impact of IT. All the areas apply to corporations with an offensive IT strategy. In corporations where IT role is "factory", only project delivery and operations governance are really critical. Finally, support roles require simplified IT service chains and operations governance.

As an overall conclusion, we underline that the governance framework is independent from outsourcing. In other terms, the IT governance focus is independent from outsourcing strategy. Actually, we have found an even stronger governance in corporations that outsource operations and/or software factories.[3]

Appendix: Who is Who: The Research Sample

Telecommunications

1. H3G: we have considered the Italian organization of H3G wth about 7 million users (http://www.tre.it)

[3] Venkatraman discusses outsourcing in a model on value creation [10]

2. Fastweb: headquartered in Milan, Italy, is now offering a convergent service (data + voice + content) with a variety of contacts and an impressive growth rate. (http://www.fastweb.it)
3. TIM: a division of Telecom Italia, is one of the most profitable mobile service provider (over 25 million customers) (http://www.tim.it)
4. Vodafone: we have considered the Italian organization with over 25 millions users (http://www.vodafone.it)
5. Wind: founded in 1997 as a division of Enel, now an independent company; has a 18% share in mobile telecommunications (http://www.wind.it)

Utilities

1. Edison: number two in power distribution, is the largest pure public corporation with in the business market (http://www.edison.it)
2. ENEL: originally a monopoly, has bee transformed in a public corporation; with over 20 million customers, is the largest power distributor in Italy (http://www.enel.it)
3. Hera: a local utility, distributes gas in Italian cities and totals over 0.5 million users (http://www.hera.it)
4. Italgas: a division of ENI Group, is in the largest gas distributor in Italy (http://www.italgas.it)
5. SNAM: a division of ENI Group, is a very large trader of gas (http://www.snam.it)

Other

- Post Office: the Italian Post Office still a state-owned organization is aggressively pursuing a multibusiness strategy through its 14,000 branches, offering mailing & logistics, financial and e-government services (http://www.posteitaliane.it)
- RCS: a publishing company, with the most important Italian newspaper and a wide offering of books and other editorial product (http://www.rcs.it)

References

1. Carr, N.G. (2003), "Does IT matter?" *Harvard Business Review*, 81(5): 41–49
2. Stewart, J. ed. (2003), "Does IT matter: A HBR debate", *Harvard Business Review*, 81(6): 12–14.
3. Nolan, R.L. and McFarlan, W.F. (2005), "Information technology and the board of directors", *Harvard Business Review*, 83(10):96–106

4. Nolan, R.L. and Gibson, C. (1974), "The four stage of edp growth", *Harvard Business Review on line*, January–February, 76–78
5. Nolan, R.L. (1985), *Managing the Data Resource Function*, West Publishing, New York
6. Francalanci, C. and Motta, G. (2001), "Pianificazione e strategia dei sistemi informativi" in: Bracchi G., Francalanci C., and Motta G. (eds.), *Sistemi informativi ed aziende in rete*, McGraw-Hill, New York
7. Capè, C., Motta, G., and Troiani, F. (2005), *Chief Information Officer*, Ilsole24Ore, Milano
8. Capè, C., Motta, G., and Troiani, F. (2005), "Chief Information Officer", *Sviluppo e Organizzazione*, 84(2): 133–145.
9. Davenport, T.H. (2005), "The coming commmoditization of processes", *Harvard Business Review*, 83(6):101–108
10. Venkatraman, N. (1997), "Beyond outsourcing: Managing IT resources as a value center", *Sloan Management Review*, 38(3):51–64

The Role of IS Performance Management Systems in Today's Enterprise

A. Perego

Abstract The paper deals with the different roles that IS Performance Management Systems can play in an organization. These systems can be used to measure how IS contributes to business value but they can be also management tools which help IS department to manage and improve its own processes and services and as a consequence IS performance. These roles are both important but usually the second role mentioned is considered a priority, in fact the most common reason which leads to the implementation of IS Performance Management Systems is to support a Governance approach to IS. The fact depends on several reasons: logical sequence of implementation process, organizational readiness, IS maturity of users, power conflicts, information asymmetry, etc. The paper analyses these aspects through the case study of an Italian insurance group.

Introduction

In the last years, Business Performance Measurement has become extremely relevant to management as a result of different changes in nature of work, in competition, in business processes, in organisational roles, in external demands and in power of Information Technology [1]. The fact could be considered peculiar because Performance Measures have been part of the planning and control cycle for a long time, but nowadays the traditional financial measures don't meet completely the requirements of Business Management. Therefore a lot of practitioners and scholars have studied a new performance evaluation framework that enriches the performance measurement with non-financial measures (e.g. customer or employee satisfaction).

The evaluation of performance is critical in all functional departments (accounting, marketing, operations, etc.); each department is involved in Performance Measurement and has to show his contribution to Business. In particularly, the control

SDA Bocconi – School of Management, Milano, Italy, angela.perego@sdabocconi.it

and governance of internal services such as Information Technology have become quite critical in organizations due to the large amount of expenditure and investment. So IS managers have faced growing pressure to measure the performance of IS department in order to justify such an appreciable investment and evaluate IS contribution to Business value. In addition frequently IS department struggles to be accepted as a full member of management team because it is not used to handle traditional management practices and tools like other departments. So the evolution of IS Performance Management Systems towards non-financial indicators provides the opportunity to use them not only as a mean to evaluate the outcomes of IS practises, processes and systems, but also as management and internal marketing tools to prove the management capability and the importance of IS department to top management and to improve the image of the IS department.

The paper shows how many times this second management-oriented role of IS Performance Management Systems is a priority as regards the traditional role focused on ex post measurement.

Theoretical Perspective

The assessment of IS effectiveness and contribution to business has been widely debated both among business scholars and practitioners. The debate started with the origin of the concept of "productivity paradox" [2–4], which suggests that traditional measures of productivity may not be appropriate to estimate the contribution of IT to business outcomes.

Since then, a lot of researchers have proposed theoretical models that show how IT investments lead to "productivity increases", "realized business value", "organizational performance improvements", and the like [5].

Weill [6] gave a significant contribution to this debate because he introduced the concept of "IT conversion effectiveness", which conveys how the impact of IT investments depends on user satisfaction, business turbulence, top management commitment on IT and IT experience of business users. DeLone and McLean [7] also contributed to increase the relevance of organizational perspective. Their first model identifies six dimensions for IT effectiveness: system quality, information quality, degree of use, user satisfaction, individual impact and organizational impact. Afterwards some researches have questioned some of the dimensions of the model, suggesting that it is important to take in greater consideration the organizational context in which the evaluation takes place. Among the other, Grover et al. [8] proposed a further dimension of analysis, distinguishing between economic and personal indicators, and suggested that the evaluation perspective influences the types of measures that become relevant. Alter [9] moves forward, by explicitly highlighting that IS effectiveness can not be empirically disentangled from the "work system" in which it gets embedded, so that quantitative measures could benefit from a qualitative interpretation of the overall experience. Others call for the consideration of the service management perspective within IS performance analysis [10, 11].

According to that, it is evident that the assessment of IS effectiveness is a challenging task because different analysis perspectives and different disciplines are involved. As a consequence IS Performance Management framework can be very complex and consider a lot of dimensions of analysis and types of measures. The most common framework used by companies is Balanced Scorecard which has been adapted for IS environment [12, 13].

Management Perspective of IS Performance Management Systems

In origin IS Performance Management Systems were implemented to define IS goals and evaluate the quantitative and qualitative returns on IS investments. Stakeholders and top management were interested in these systems and sponsor them, according to the balanced scorecard methodology [12].

Today these systems play another important role in organization: they are IS Governance [14], which help CIO to manage IS department, understand the reasons of the actual performance, define how to improve practices and procedures to align better IS to business changes and finally improve IS performance. This role, which links "measurement" to "management", is sponsored by CIO and IT Manager who need more frequently and timely ex post measures as management tools. In confirmation of this trend, international standard methodologies, like CobiT, are adding the concept of process KPI in their traditional approach based on the measurement of results.

Usually it is not possible to play both roles in the beginning of the implementation process of these systems and the second role is considered a priority for several reasons:

1. *Logical sequence in implementation process*. In fact, the knowledge of IT processes and the management of them is an essential condition to apply Service Management and utilize the results of IS performance measurement in order to improve the quality of IS services and so IS performance itself. In addition, to feed IS Performance Management Systems it is necessary to have source data which are produced by many IS management tools (e.g. accountancy of IS costs, IS human resource management, project management systems, customer survey and Help desk automation). In few companies all input data are currently available. So the first steps of the design and development of an IS Performance Management platform are the development of a solid framework of IS management and its automation level. Besides IS Performance Management design and development can encourage an effort to reengineer IT processes and IS department reorganization.
2. *IS maturity of user departments*. In most organizations user departments are not interested in understanding how IS department provides IT services and if these services are real consistent with their needs. The interest in Information

Technology is generally very low and top management is not used to handling sophisticated IS performance indicators (KPIs).
3. *Information asymmetry between IS department and the rest of the organization*. Usually user departments don't understand the complexity of IS activities. As a consequence they are not able to analyse IS performance indicators as regards the IS organizational context in which the evaluation takes place, so the utility of them tends to be lower. In same cases management can misunderstand the real meaning of IS performance indicators and, as a result, it takes wrong decisions.
4. *IS department readiness*. Many times IS department haven't got competencies and structured management tools (see point 1) to deal with this issue. So they have to educate and train themselves to a modern and more sophisticated IS Management framework.
5. *Power struggle*. The power of IS department depends on the amount of IS budget and resources that it manages. As IS Performance Management Systems lead to a "transparent" communication between IS department and user departments, they could reduce IS Department power, especially in case of inefficient situation or opportunistic behaviour.

This new role of IS Performance Management Systems changes also their design and development because outputs like IS services Catalogue and Service Level Agreement are not by-product of the implementation process but some of its main outputs [14]. These outputs are as important as IS performance Indicators.

MRI Case Study

MRI[1] is a big Italian Insurance Group with 770 agencies in Europe, 2,812 employees and 3 billion euro of premiums collected in 2006. The Group, which consists of eight companies, operates through a variety of distribution channels: traditional agent, financial advisor, broker and bank channels and the new telephone and Internet channels.

The business context complexity of MRI makes Information Technology even more strategic and relevant so as to maintain its market share. Therefore the task of IS department becomes more difficult because an increase in IS strategic value leads to an increase in complexity of IS resources management and to the necessity to consider IT as a service and as a consequence to apply Service Management rules and practices.

MRI has one IS department for all the companies and two years ago it started to shift from product driven organization to process driven organization in order to answer better needs of IS internal customers. In spite of this change IS department and MRI organization were not ready to use and manage IS as a service and handle IS performance indicators.

[1] MRI is a fictitious name because the author hasn't got the authorization to disclosure the real name yet.

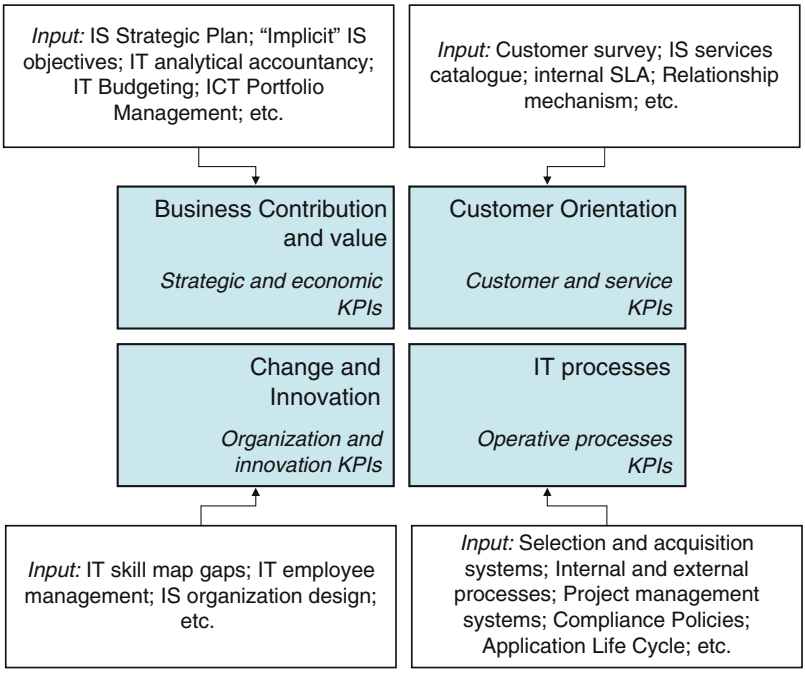


Fig. 1 Inputs to IS performance management framework

IS department hadn't got convenient IS Governance tools and high automation level of IS management systems. Furthermore IS people were not used to tracking their activities and to guaranteeing quality levels. IS department couldn't measure and, as a result, know its performances. So it would have been difficult to discuss improvements in performance or in economic and human resources required. On the other hand Top management and user departments were not really interested in analysing how IS department performs and consequently they didn't waste time to understand the peculiarity of IS environment, even if often they claimed about IS applications. In fact RMI Group was doing well and so the pressure to reach cost effectiveness and to improve level of quality was not so high, but the situation was changing. So CIO decided to implement an IS Performance Management System in order to learn how to deal with these new challenges, management practices and methods of work and to be ready to answer future needs of MRI Group.

The framework of IS Performance Management applied in MRI is loosely based on the Balanced Scorecards [15]. This framework aims at providing a set of metrics that allows a continuous monitoring of IS related operations and outputs and at designing the processes to calculate and implement them. The main MRI aims were to change IS perspective and to built the necessary tools for a sustainable change. The definition of KPIs was obviously important but it would have been useless without convenient tools and procedures to sustain it and without a complete understanding of their real meanings. As a result, a lot of time was spent to discuss and share within the IS Committee members the inputs for IS Performance Management methodology (Fig. 1), evaluating them as key results and not as by-product: IS

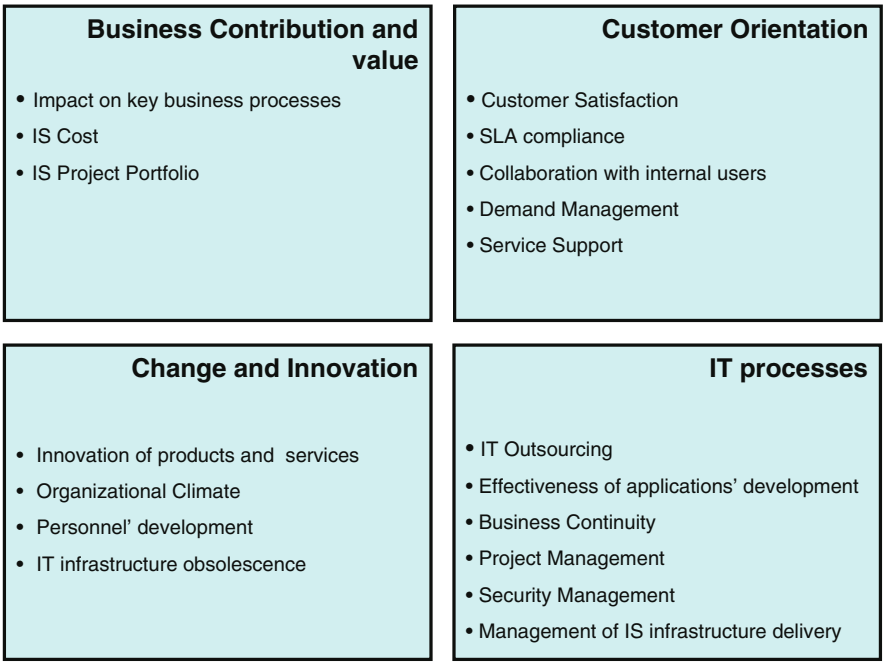


Fig. 2 Measurement's objectives of MRI IS performance management system

processes design, IS management tools (application portfolio management, project portfolio management, demand management, IT Cost Accounting, etc.), IS services catalogue, Service Level Agreement, etc.

IS department utilized these outputs to start communication and "marketing" activities towards internal users and, as a result, decrease information asymmetry between IS department and user departments and increase IS maturity as a whole.

Finally it was defined the set of metrics (KPIs), their descriptions, algorithms, unit of measurement, owner, update frequency, source data and systems. In MRI the four key measurement areas (Fig. 2) were designed as follows:

1. *Business contribution and value*, whose aim is to demonstrate to stakeholders how IS services support business strategic objectives, in terms of impacts on key business processes, IS cost dynamics and IS Portfolio prioritization.
2. *Customer orientation*, which measures the satisfaction of internal customers, SLA compliance, the collaboration level between IS Department and user departments, how Demand Process is managed and service support is delivered.
3. *IT processes*, which evaluates if IS processes (IT Sourcing, IT development and implementation, IT security, IT operation and service delivery, etc.) are efficient, complete and compliant to the best international practices.
4. *Change and innovation*, which inquires if IS department has got the necessary resources (managerial and technical skills, IT intelligence capabilities, etc.) or

conditions (organizational climate or IT infrastructure obsolescence) to deliver organizational and technical innovation.

Nowadays MRI is deploying and refining its IS Performance Management System in order to sophisticate it and increase organizational readiness of the Group, especially top management, to use it in an actively and worthwhile way.

Conclusions

This paper debates how many times IS Performance Management Systems loose their traditional role and scope spring from Performance Measurement approach and become mainly dynamic IS management tools. As a consequence their objective is to support CIO in resource allocation, in projects and investment evaluation, in opportunities or bottlenecks findings to support decision making for continuous improvement. They help IS department to improve its management capability and to show its results with facts and figures like other departments. They can also provide to top management useful outcomes to evaluate IS effectiveness but usually this is not the main reason of their implementation.

References

1. Neely, A. (1999). The Performance Measurement Revolution: Why Now and What Next?, *International Journal of Operations & Production Management*, 19(2): 205–228
2. Solow, R.S. (1987). *We'd Better Watch Out*, New York, Times Book Review
3. Strassmann, P. (1990). *The Business Value of Computers*, New Canaan, CT, The Information Economics Press
4. Brynjolfsson, E. (1993). The Productivity Paradox of IT, *Communications of the ACM*, 36(12): 66–77
5. Soh, C. and Markus, M.L. (1995). How IT Creates Business Value: A Process Theory Synthesis. Proceedings of the 16th International Conference on Information Systems, pp. 29–41
6. Weill, P. (1992). The Relationship Between Investment in Information Technology and Firm Performance: A Study of the Value Manufacturing Sector, *Information Systems Research*, 3(4): 307–333
7. DeLone, W.H. and McLean, E.R. (1992). Information Systems Success: The Quest for the Dependent Variable, *Information Systems Research*, 3(1): 60–95
8. Grover, G., Jeong, S.R., and Segars, A.H. (1996). Information Systems Effectiveness: The Construct Space and Patterns of Application, *Information & Management*, 31: 177–191
9. Alter, S. (1999). The Siamese Twin Problem, *Communication of AIS*, 2(20): 40–55
10. Pitt, L.F., Watson, R.T., and Kavan, C.B. (1995). Service Quality: A Measure of Information Systems effectiveness, *MIS Quarterly*, 19(2): 173–188
11. DeLone, W.H. and McLean, E.R. (2002). Information Systems Success Revisited. Proceedings of the 35th Hawaii International Conference on Systems Science, Kona-Kailua, Hawaii
12. Kaplan, R. and Norton, D. (1996). *The Balanced Scorecard: Translating Strategy into Action*, Boston, MA, Harvard Business School Press

13. Martinsons, M., Davison, R., and Tse, D. (1999). The Balanced Scorecard: A Foundation for the Strategic Management of Information Systems, *Decision Support Systems*, 25: 71–88, Science Direct
14. Pasini, P. and Canato, A. (2005). Is Performance Management: An Action Research Perspective. Proceedings of the 1st Conference of Italian Association of I.S., Verona
15. Pasini, P., Marzotto, M., and Perego, A. (2005). *La misurazione delle prestazioni dei sistemi informativi aziendali*, Milano, Egea

A Methodological Framework for Evaluating Economic and Organizational Impact of IT Solutions

M. Ruffolo[1] **and M. Ettorre**[2]

Abstract The importance of the role of Information Technology (IT) for Knowledge Management (KM) within many companies has been widely recognized, but its impact on organizational performance has resulted difficult to be evaluated. Most of the difficulties depend on the variety and the typology of organizational variables, and on the relevant number of the involved actors. This paper provides a methodological framework to analyze the consequences of adopting IT tools for managing information and knowledge; in particular, advantages on performance, efficiency and efficacy metrics, investment profitability, and technological usability are investigated. The aim of the proposed methodology coincides with the main target pursued by firms: to have the possibility of evaluating IT solutions both ex ante, i.e. at the project/design phase, and ex post, i.e. at the assessment phase.

Introduction

The current economic context is characterized by an ever growing global competition and complexity; thus, companies need to focus on exclusive resources, such as knowledge and capabilities, to acquire and maintain a competitive advantage. Knowledge has assumed the role of strategic resource and every organization should develop its capacity to generate, store, share and apply knowledge [1, 2]. Knowledge Management (KM) concerns the development and usage of tangible and intangible resources in a superior way as to improve performance of firms: a strong effort in building the appropriate infrastructure for knowledge diffusion and for the coordination of business processes is of primary importance [3]. Information Technology (IT) represents the main knowledge transmission vehicle within the firm, as it allows the suitable integration between knowledge management and organization. Indeed,

[1]CNR - ICAR, Pisa, Italy, ruffolo@icar.cnr.it
[2]Università della Calabria, Exeura s.r.l., Arcavacata di Rende, Cosenza, Italy, ettorre@exeura.it

Table 1 Business processes catalog

Processes		Involved Actors	Description
Process 1	Activity 1.1	Actors profile	...
	...	...	...
	Activity 1.n	...	...
Process m	Activity m.1	Actors profile	...
	...	...	...
	Activity m.p	...	...

once the acquired skills and competences are considered as key success factors, they should be included in the business organizational context, by properly integrating not only human and knowledge resources, but also technologies and organizational processes (Table 1).

Several KM tools and techniques support the performance of organizational activities and facilitate the implementation of knowledge processes [4]. But, even if IT is the key enabler of the implementation of KM processes and the primary support of a KM system [5], it does not guarantee the efficiency and the efficacy of business processes [6, 7]. KM tools can only be understood in the organizational context in which they are used. As a consequence, the adoption of IT solutions requires the analysis of human and organizational variables and the codification of interpretative procedures [8]. Therefore, the definition of an organizational support which serves managers to introduce and implement IT for KM assumes a crucial role and a global relevance in the business environment.

In literature, the most diffused and applied intangible asset evaluation methodologies, such as the Technology Broker [9], the Intellectual Capital Index and the Skandia Navigator [10], the Balanced Scorecard [11] and the Intangible Assets Monitor [12] consider IT as one of the many managerial variables. Instead, our attention is pointed at those methodologies that analyze the consequences derived by the introduction of an IT solution on the business performance. A significative number of papers have focused their attention on particular aspects of the organizational and economic impact of IT investments for KM. For instance, in [13, 14] have been defined a model to evaluate the satisfaction of stakeholders of KM initiatives. In [15, 16] have been analyzed the interrelationship between KM initiatives and organizational variables, providing methodologies to evaluate their reciprocal influence. All these methodologies have stressed the difficulty of evaluating the organizational consequences of the introduction of IT technologies for KM. This difficulty springs from the coexistence and the simultaneous interaction of tangible and intangible factors, and from the involvement of several actors during the implementation phase.

Our approach is aimed to design a methodological framework, which supports executives and organizational analysts in evaluating – both at the project/design phase (ex ante) and at the assessment phase (ex post) – organizational and economic performance of IT solutions for knowledge and information management. In

particular, our framework defines quantitative and qualitative elements to determine the performance improvement of knowledge life-cycle in terms of cost and time reduction, profitability, productivity, cost/benefits ratio, usability of IT solutions, and information quality.

This paper is organized as follows. In section, "Methodological framework", the proposed framework is described in the details. Section, "Case study and results", provides the case study application on a university spin-off specialized in consulting for KM processes. Section, "Conclusions and future development" draws conclusions through a discussion on the results of the research and on its further developments.

Methodological Framework

In "Show Me the Money – Measuring the Return on Knowledge Management", [17] shows four critical factors, which enable KM technology in terms of economic impacts: internal costs, revenue increase, return on investment and cost/benefit analysis. The aim of the proposed framework is to evaluate all of these factors, to analyze organizational and economics impact of a specific IT solution for KM.

The proposed methodology is constituted by five phases (see Fig. 1), and each one is composed of a set of actions. In the following, each phase will be described in details.

Phase One: Definition of Business Performance

The objective of this phase is the definition of the organizational areas involved into the evaluation process and the estimation of the IT solution benefits in terms of time and cost reduction, profitability, productiveness, cost/benefit ratio, usability and quality of information shared.

The evaluation can be ex-ante (when it is aimed to estimate the goodness of an IT solution that will be implemented in the future), in itinere (to control if an IT solution meet the business needs and provides good performances), ex-post (when the organization needs to understand the level of the benefits produced by an existing IT solution).

Phase Two: Definition of Technological and Organizational Model

In this phase, a schematic representation of the firm is defined under the technological and organizational point of view. Using software engineering and Business Process Management tools (Unified Modeling Language – UML, Business Process

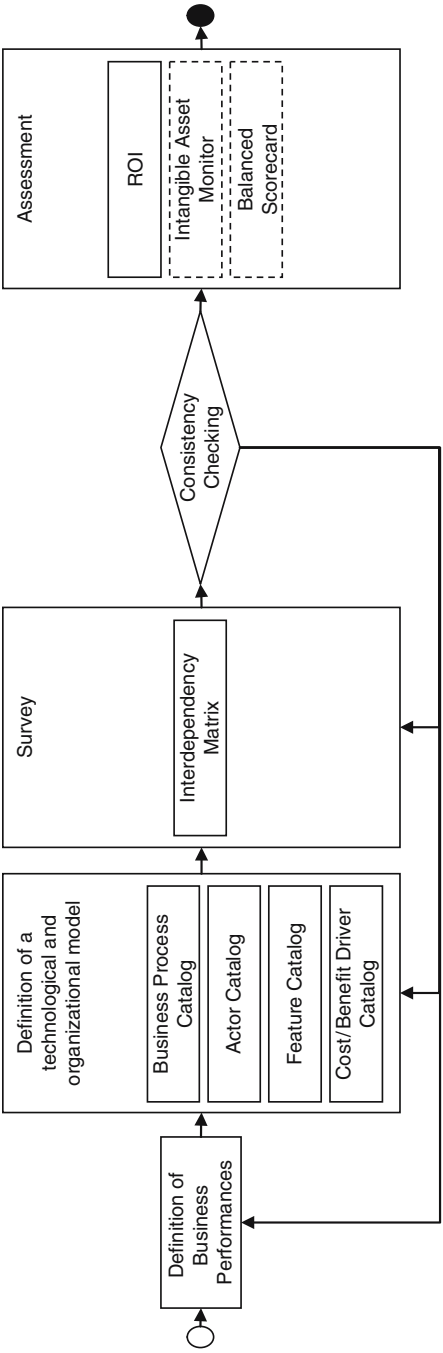


Fig. 1 The logical flow of the methodological framework

Table 2 Actor catalog

Typology of actors	Actors	Competences, Skills, Expertise
Employee	Actor 1	...
	...	...
Client/supplier	Actor j	...
	...	...
Automatic (system and machinery used by the actors)	Actor n	...
	...	...

Reengineering – BPR, Activity Based Costing – ABC), a set of four catalogs (1. business processes catalog, 2. actor catalog, 3. feature catalog, 4. cost/benefit driver catalog) is developed. These catalogs aim at describing synthetically the most relevant technological and organizational aspects (business processes and their activities, organizational actors, system features, cost/benefit drivers) having impact on the evaluation process:

1. *Business Processes Catalog*. IDEF and UML tools are used to represent business processes. For each process, the activities and their mutual relationships and interdependencies are defined. Then, actors performing each activity are identified.
2. *Actor Catalog*. Organizational actors are classified on the basis of their competences, skills and expertise after that the organizational structure is defined (e.g. process oriented, divisional, functional, etc.). Actors can be represented using the UML actor diagram, useful to represent mutual dependencies and hierarchies, and/or with the job description. The purpose of actor catalog is to clearly represent the profile of the end user of the IT solution (Table 2).
3. *Feature Catalog*. Features of the IT solution are identified by the Feature Driven Development Agile Software methodology. Requirements of the system are clusterized so that each cluster is composed by a set of homogeneous features (Table 3).
4. *Cost/Benefit Driver Catalog*. Cost/benefit driver are identified by the Activity Based Cost technique, applied to the process activities in which one or more features of the IT solution are involved. Cost driver, revenue driver and intangible asset driver are build. In sum, this catalog concerns cost/benefit variables directly involved by the IT solution (Table 4).

Table 3 Feature catalog

	Feature	Description
Cluster 1	Feature 1.1	End user career brief, and number of end users
	...	...
	Feature 1.n	
Cluster m	Feature m.1	End user career brief, and number of end users
	...	
	Feature m.p	

Table 4 Cost/benefit driver catalog

Typology	Driver	Description	Formula
Cost	Driver 1	…	…
Revenue	Driver j	…	…
Intangible	Driver n	…	…

Phase Three: Survey

In this phase, the elicitation of the relation among process activities, system features, actors and cost/benefit driver are realized by the Interdependency Matrix (next table) which is able to show synthetically the set of drivers for a given combination of activities, system functionalities and actors. In this way, it is possible to identify the drivers to be measured for a given combination of "activities, feature, actor". Then, by the Estimation Matrix, the best drivers are evaluated: it is used to estimate (ex ante) or to measure (ex post) the cost/benefit driver and the intangible asset driver. The results of the Estimation Matrix represent the basis to measure economical impact of the IT solution (Table 5).

Phase Four: Consistency Checking

The consistency of the interdependency matrix is checked in order to assess if the structure of the interdependency matrix is able to explain and justify the evaluation goals.

Phase Five: Assessment

The measures obtained in the survey are used to calculate Return on Investment (ROI). When cost/benefit drivers include a significant number of intangible asset drivers, a method like balanced scorecard and/or intangible asset monitor can be used for the assessment.

Table 5 Estimation matrix

Processes		Features		Driver		
Process	Activity	Feature	Actors	Driver 1	…	Driver n
Process 1	Activity 1.1	Feature 1	…	…	…	…
		…	…	…	…	…
		Feature n	…	…	…	…
	Activity 1.2	Feature e 1	…	…	…	…
		Feature 2	…	…	…	…
			…	…	…	…
		Feature m	…	…	…	…

Case Study and Results

Exeura s.r.l. is a company operating in the Knowledge Management (KM) field of the Information and Communication Technology (ICT). It was born as a spin-off from the University of Calabria (UNICAL) in 2002. The initiative originates from the perception of the gap existing between research and industrial production in the ICT field. The purpose of Exeura is that of acting as a link between these two "worlds". In 2004, managers of Exeura decided to adopt a new technology to enable semantic management of own business process. The new technology (KMS-Plus[1]) is modular, reusable, and portable in different organizations. Main purpose of KMS-Plus platform is to support business process execution with the potential of Knowledge Management.

The proposed methodology, shown in the previous paragraph, has been tested to assess the organizational impact of the KMS-Plus Platform. The results will show the level of performance that the firm could reach adopting the IT solution.

Firstly, the management of Exeura has defined business performance reaching with the new system. In particular, he has identified the following benefits: improvement of managerial, operational and decisional processes; growing up of internal efficacy and efficiency; improvement in knowledge generation, store, share and application; enabling process and product innovation feasibility; improvement of client/supplier relationship management.

Then, Business processes catalog, actor catalog, feature catalog and cost/benefit driver catalog developed in the Exeura case study have been used to build the Interdependency Matrix. Then, by the Estimation Matrix, cost/benefit driver and intangible asset driver have been measured after the implementation of the IT solution. Partial results of the experiment are shown in the table above (Table 6).

Results of the study show that the introduction of the KMS-Plus technology to knowledge management in the business activities of Exeura gives rise to the following benefits:

- Increasing of more than 10% for personnel productivity (this is because employees are able to carry out the same activities saving 15% of time)
- Saving of 20% for training time
- Increasing of 10% for market value per advisor (because of the increased knowledge circulation and the reduced training time)
- Saving of 20% for personnel complaints

The ROI estimation starts with the results obtained with the survey. The value of the investment in the IT solution was estimated in 400,000.00 €. Results of the survey suggest a reduction in the time production of about 2,000 h. This means that the revenue can be estimated in increasing of about 19%; finally, the results suggest that the revenue per year directly referable to the new IT solution is about 150,000.00 €, that means a 3 year pay back period for all the investment.

[1] KMS-Plus is a system for semantic business process management based on an architecture that combines peer-to-peer and Web-oriented approaches. The system allows to exploit knowledge within processes by representing it through ontology and workflow.

Table 6 Estimation matrix for the exeura case study

					Personnel costs		Training costs	
Typology	Actors	Total annual hours	Production hours	Training hours	Costs per hour	Operational costs	Teaching costs	Training costs
Internal employees	Manager	1,670	1,670	0	42	70,140	0	0
	Administrative personnel	2,088	1,670.4	417.6	10	16,704	2,600	6,776
	Project manager	1,000	800	200	22.7	18,160	0	4,540
	Researcher	1,000	800	200	22.7	18,160	1,600	6,140
	Architecture designer	2,000	1,600	400	22.7	36,320	0	9,080
	Software designer	5,010	4,008	1,002	18.8	75,350.4	2,000	20,837.6
	Quality manager	505	404	101	22.7	9,170.8	0	2,292.7
	Programmer analyst	6,680	5,344	1,336	14.32	76,526.08	0	19,131.52
	Presales engineer	505	404	101	22.7	9,170.8	0	2,292.7
	Partial total	20,458	16,700.4	3,757.6		329,702.08	6,200	71,090.52
	Total							400,792.6

Conclusions and Future Development

The methodological framework described in this paper has been adopted to analyze the performance deriving by the adoption of an IT solution for KM. Results show that the adoption of the IT solution can enhance the performance of the firms both from the technological and the organizational point of view.

From a managerial point of view, the proposed framework could help manager in performing the IT tools for KM activities, while from a methodological point of view, it adds a new step in the analysis and measurement of the performance of IT tools for KM.

Aware of the limits of the framework, next step of the research will be the adoption of the methodology in other typology of firms (e.g. big firm) and also in other business sector. Moreover, the adoption of balance scorecard methodology may help to improve, validate and consolidate the methodology, which aims to support management of firm in evaluating the performance of an IT solution to manage knowledge and information in a more appropriate way.

References

1. Nonaka, I. and Takeuchi, H. (1995). *The Knowledge Creating Company*. New York, Oxford University Press
2. Tiwana, A. (2000). *Knowledge Management Toolkit: The Practical Techniques for Building a Knowledge Management System*. Englewood Cliffs, NJ, USA, Prentice Hall
3. Davidow, W. H. and Malone, M. S. (1992). *The Virtual Corporation: Structuring and Revitalizing the Corporation for the 21st Century*. New York, Harper-Collins
4. Tyndale, P. (2002). A taxonomy of knowledge management software tools: Origins and applications. *Evaluation and Program Planning*, 25(2):183–191
5. Reyes, G. and Chalmeta R. (2005). A methodological approach for enterprise modeling of small and medium virtual enterprises based on UML. Application to a tile virtual enterprise. *First International Conference on Interoperability of Enterprise Software and Applications*, Geneva 21–25 of February
6. Davenport, T. H. and Prusak, L. (1998). *Working Knowledge: How Organizations Manage What They Know*. Cambridge, MA, Harvard Business School Press
7. Hansen, M. T., Nohria, N., and Tierney, T. (1999). What's your strategy for knowledge management. *Harvard Business Review*, 77:106–116
8. Bloodgood, J. M. and Salisbury, W. D. (2001). Understanding the influence of organizational change strategies on information technology and knowledge management strategies. *Decision Support Systems*, 31(1):55–69
9. Brooking, A. (1996). *Intellectual Capital: Core Assets for the third millennium enterprise*. London, Thomson Business Press
10. Edvinsson, L. and Malone, M. S. (1997). *Intellectual Capital: Realizing Your Company's True Value by Finding its Hidden Brainpower*. New York, Harper Business
11. Kaplan, R. S. and Norton, D. P. (1996). *The Balanced Scorecard – Translating Strategy into Action*. Boston, Harvard Business School Press
12. Sveiby, K. E. (1997). *The New Organizational Wealth: Managing and Measuring Knowledge-Based Assets*. San Francisco, Berrett-Koehler

13. Carlucci, D. and Schiuma, G. (2002). How knowledge management initiatives impact on business performance. *Proceedings of 3rd European Conference on Knowledge Management*, 24–25 September, Trinity College, Dublin
14. McHugh, M., Ray, J., Glantz, E. J., Sundaresan, S., Pal, N., and Bhargava, H. K. (2002). Measuring the business impact of knowledge management. *Proceedings of the 5th World Congress on Intellectual Capital*, 16–18 January, Hamilton, Canada
15. Corso, M., Martini, A., Paolucci, E., and Pellegrini, L. (2001). Knowledge management in product innovation: An interpretative review. *International Journal of Management*, 3(4):341–352
16. Iftikhar, Z., Eriksson, I. V., and Dickson, G. W. (2003). Developing an instrument for knowledge management project evaluation electronic. *Journal of Knowledge Management*, 1(1):55–62
17. Martin, K. (2002). Show me the money – measuring the return on knowledge management. Law Library Resource Xchange, LLC. (http://www.llrx. com/features/kmroi.htm)

Part VI
Track: Education and Training in Information Systems

C. Rossignoli

Information Systems (IS) represent a classical field of study since the 1960s, when business computers began to be widely adopted in different businesses. The academic dimension of Information Systems (IS) was enlarged and deepened as information and communication technologies (ICT) became more pervasive in operative processes and in supporting decisions and management strategies.

The new role of organizational competences necessary to conduct IT services have also pressed the academic curriculum to consider these subjects as eminent both in management and engineering areas.

To understand these origins and their consequences it is necessary to start from the differences between Computer Science and Information Systems: computer science is based on the functionalist paradigm, while information systems, at least in their modern form, are based chiefly on the socio-technical paradigm, to arrive in the latest period to rely solely on social theories (e.g. structuration theory in Orlikowski [1]). On these themes and on the definition of the different domains, an interesting and heated debate has been on going since the early 1990s. The first scholar to discuss the subject was Claudio Ciborra followed by others. The richness of this discussion is reflected in the wealth of the curricula proposed in different business schools and universities.

One of the aims of this chapter is to investigate the relevance – in to-day's changing world – of the traditional themes and contents taught in IS curriculum. There is a paper (Albano, Contenti, D'Atri, Scaffidi Runchella) that tries to examine ways in which the fast paced shifts in requirements of the business community can be integrated in the construction of a similarly changing curriculum. These changing requirements can include the continuous development of knowledge and competences as requested by firms that have adopted new ICT but also the necessary cultural framework for working and competing in the flat world. Another paper (Gazzani Marinelli, Di Renzo) explores which new approaches and teaching methodologies could be used in computer assisted education. Finally the third

Universita di Verona, Verona, Italy, cecilia.rossignoli@univr.it

one (Cavallari) considers the human computer interaction and system security in an organizational appraisal.

Reference

1. Orlikowski, W. J. (1992). The Duality of Technology: Rethinking the Concept of Technology in Organizations. *Organization Science*, 3 (3), 398–427

Surveying Curricula in Information Systems in the Italian Faculties of Economics

V. Albano, M. Contenti, and V.S. Runchella

Abstract In this paper the current offer of programs and courses in IS, focusing on the Italian faculty of economics, is investigated. More in details the Master of Science in Information Systems (MSIS06) model and the Italian ministerial class for second degree 100/S are taken as a reference for a quantitative evaluation.

Introduction

Several phenomena as the rapid technological innovation, the growing competitiveness and dynamism of markets and the changing role of IS in organizations give rise, over years, to a notable evolution of the IS professions [1].

Also influenced by the industrial demand for new professionals, the need to promote innovative and interdisciplinary curricula in IS, spanning through technical, managerial and legal competences, emerges in the academia. This is proved by the progressive enrichment, in many faculties and in particular in those of economics, of undergraduate and graduate programs and courses in IS, oriented to provide qualified competences in the management of IS. Actually more than 200 are the MSIS curricula registered in the AIS world net dedicated area [2]. In a debate during over 30 years, also notable have been the efforts, spent by prestigious international associations of academics and professionals operating in the computer science, engineering and information systems disciplines and markets, to define, promote and continuously update models for IS curricula (e.g. [3, 4]). Actually in providing guidelines to support the design of programs in IS, the definition of specialized curricula, based on a clearly defined core body of knowledge and skills peculiar for an expert in IS, strengths the identity and the autonomy of the IS discipline and its boundaries [5].

Nevertheless, whereas the relevance of the education in IS in the business curricula is widely recognized and even in Italy the debate is intense [4], in our knowledge

Università LUISS – Guido Carli, CeRSI – Centro di Ricerca sui Sistemi Informativi, Roma, Italy, valbano@luiss.it, mcontenti@luiss.it, vscaffidi@luiss.it

not enough efforts have been spent in the evaluation of the actual presence of programs and courses in IS in the Italian academia. To this aim in this paper the current offer of programs in IS, focusing on the faculties of economics is investigated. More in details the Master of Science in Information Systems 2006 (MSIS06) model is taken as a reference for a comparison base.

Among the several ministerial classes of second degree, the class 100/S has been evaluated as the more relevant and the trend over years of the afferent programs is observed and discussed. Also, the structure and topics of the actual programs implementing the class 100/S for the academic year 2006–2007 is evaluated and discussed in greater details.

The rest of this paper is structured as follow: in section "Method" some methodological considerations are provided; the results of our investigation are presented in section "Results" and a discussion on the outcomes is provided in section "Conclusion".

Method

In our evaluation the MSIS06 model [6] is taken as an authoritative reference for comparison base. The model is the fourth issue of a collaborative effort jointly promoted by the Association of Computer Machine (ACM) and the Association of Information Systems (AIS). It provides a guideline for the design of second level programs in IS, specifying a minimum common body of knowledge for all MSIS graduates. By adopting this curriculum, faculty, students, and employers can be assured that MSIS graduates are competent in a set of professional knowledge and skills and are instilled with a strong set of values essential for having success in the IS field. The building blocks of the curricula are depicted in the figure below (Fig. 1).

The MSIS06 is characterized by a highly flexible structure, enabling the modeling of different curricula, varying in respect of the institutional constraints and the student's background and objectives. Nevertheless it is based on the American and Canadian university models. This aspect implied several limits to a valuable comparison with the Italian curricula. However, as the authors themselves suggest, the real added value of the MSIS model is in the recommendations on the structure of the course and on the definition of a distinctive core body of knowledge for the IS professional [6]. Actually these are the main aspects that should guide the design of programs and promote the standardization of competences.

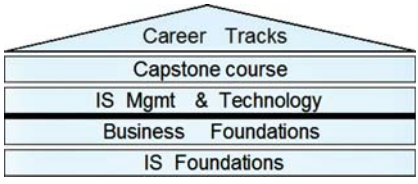


Fig. 1 MSIS06 curriculum elements [6]

In this perspective the comparison of the Italian curricula with the MSIS06 model has been centered on the analysis of the programs' structure with the aim to evaluate whether and up to which extent they are consistent with logic proposed in the MSIS06 model.

Considering that the target for the MSIS06 model are graduate students, for what concerns the Italian scenario the relevant courses and programs were identified starting from an analysis of the ministerial classes of second degrees. Both for the similar objectives and coverage of topics, among the more than a hundred classes, the class 100/S, called Techniques and methods for the Information Society, emerged as the more meaningful to take as a reference.

Nevertheless, although the MSIS06 model and the class 100/S can be considered at the same level of abstraction, only some macroscopic qualitative considerations, discussed in the next section, were possible. Actually a deep comparison, based on the topics recommended by the two templates, was mostly prevented by the fact that whereas the MSIS06 model is sharply bounded to cover courses to be provided in a MS program over 1 or 2 years, the specification of topics in the class 100/S takes as a reference a wider curricula, also considering courses supposed to be attended in the undergraduate programs. Moreover, even if the classes of second degree were recently reformed and in the new class LM91, corresponding to the previous class 100/S, this problem has overcome, the specification of the new class appear as being not mature enough for a valuable comparison. Actually in the new coming academic year 2007–2008 the previous classes of second degree is still in force.

Thus, although operating at a different level of abstraction, the analysis proceeded examining for the comparison the actual implementations of curricula afferent to the class 100/S, currently provisioned in the Italian faculties of economics. The documentation taken as a reference was the one publicly available on the website of the faculties. Even in this case, the co-presence of several different logics in the structure of programs prevents the adoption of quantitative methods of analysis. A mixed investigation was then conducted to analyze the respective programs structure and topics. In details, both the sets of mandatory and predefined optional course were considered and, in order to evaluate the degree of coverage of the MSIS06 model, more precisely of the body of knowledge, the educational objectives and the topics of the single courses included in each of the syllabus were evaluated.

Results

The specific topics covered in the class 100/S show several analogies with the more advanced curricula in IS internationally designed and adopted. Similarly to the MSIS06 model, the class 100/S targets the education of professionals with advanced competences in technological and organizational changes, promoting the integration between the computer science and the managerial cultures. The class 100/S is afferent to the macro-area of social sciences, and it finds in the faculties of economics the natural place for its implementation; at the same time it also advises for the institution of partnership with other faculties, scientific and technical, with

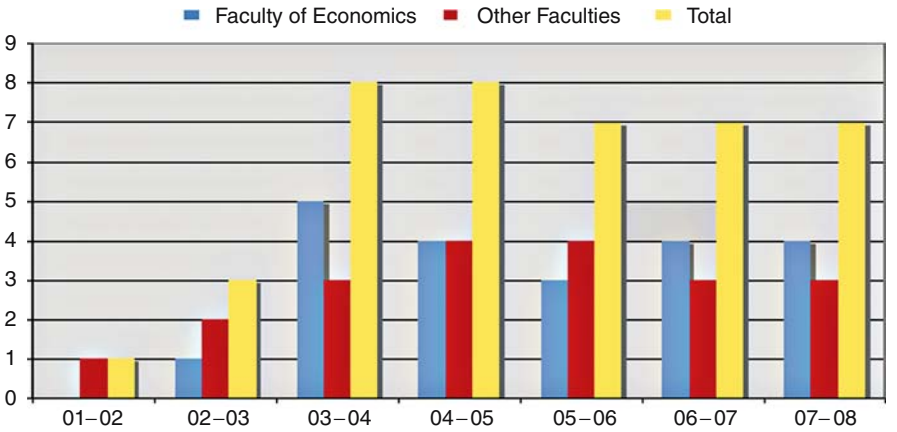


Fig. 2 Diffusion of programs afferent to the class 100/S: years 2001–2008

the aim to promote and offer a real and effective multidisciplinary education. The figure below shows the trend over the last 7 years in the diffusion of programs afferent to the class 100/S; both the offers by faculties in economics and faculties in other disciplines is considered (Fig. 2).

The graphic puts in evidence how in respect to other more dynamic environments, the Italian academia seems to be slow in recognizing the strategic role of the education in IS. Looking at a greater detail the structure of MS's programs, three out of four have been directly activated by a faculty of economics, the fourth within a partnership between the faculties of economics and engineering of the same university. A fifth program have also been included in the evaluation; even if activated in a faculty in Mathematical, Physical & Natural sciences, the program presents a strong orientation towards legal–economics topics, deserving attention. In the last two programs the evident multidisciplinary nature and the possibility to receive students with heterogeneous backgrounds induced the parallel activation of different orientation within the programs (two in the former and three in the latter) varying with the more technical or economical competences formerly acquired by the attending students.

This approach appears extremely coherent with the flexible nature of the MSIS06 model, which recognize the need to customize the programs in respect not only to the educational objectives defined in the model itself but also with the students' previously acquired competences [6].

In the following the qualitative results of the deep evaluation of these overall eight programs are presented. In the discussion a direct reference to the basic building block of the MSIS06 model is performed, and a brief summary of each block precedes our discussion as follow.

In respect with Foundation courses and in order to accommodate students from a wide variety of background, the MSIS06 model specifies a minimum foundation of essential preparatory knowledge. In particular, it includes IS Foundations and Business Foundations blocks of courses as prerequisite to prepare students for the following of the curricula. Accordingly to the essential prerequisite in the MSIS06

model, the Italian curricula seem to have acknowledged the importance of at least one course in programming: five out of the eight programs include a course in this topic prevalently focused on web programming. In one program, the course in programming is coupled with another course dealing with hardware and software. Although this option is explicitly excluded in the MSIS06 model, being the competence in hardware and software considered as prerequisite, the presence in that particular program may be interpreted as the need to provide these introductory competences to an audience mostly composed by students with a background in business and economics. Rather limited is instead the presence of courses on Fundamental of IS. Only three curricula, indeed, include an introductive course in IS. Moreover confronting the syllabuses with the respective MSIS06 course, only in one case the main objectives effectively provide a preliminary and complete vision of the IS and the relationship between IT and Organization, while in the other the focus is more on some specific area of IS (e.g. Executive Information systems) or in topics of computer science.

The contained correspondence with the MSIS06 guidelines may be justified by the fact that among the analyzed courses at least three target students with a solid technical background. Nevertheless the absence of IS fundamentals, and in particular of introductive course in IS for the students with an economic background is hardly justifiable. Even in the sole case in which a similar course is included, its placement at the second year undermines its introductory valence.

The second component of the MSIS06 foundation is the business area block. The number and the topics covered by the economics and business courses included in the programs vary dramatically from institution to institution. Every program includes at least one course in the economic domain, in three cases there are three, and in one up to six. The numeric variance seems to be related with the specific background of the target students and by the structural characteristic of the class 100/S. Being afferent to the social science macro area, this class reserves an high number of credits for topics typical for this area (e.g. law, economics and mathematical studies), which, if not covered in the undergraduate curricula, would constitute educational debts to be covered before getting the degree. In respect with the coverage of topics, they transcend those specified in the MSIS06 model. In particular two different classes of courses are identifiable: those related with fundamentals in business or specific for business functions (Organization, Marketing e Logistic) more present in the curricula for students with technical background; the advanced one, namely those mostly focused to the impacts of ICT on the economic domain and on the business strategies. In some cases also other additional courses in the economic disciplines are included. Even if lacking in courses on IS fundamentals, the Italian curricula distinguish for the richness and variety of courses in the business area, at the point that some of the programs seems more similar to an MBA or an MS in Economics program with additional coverage of some technological competences, rather than to a MSIS one.

If the distance between the Italian curricula and the MSIS06 in respect with the areas of IS fundamentals and Business fundamentals may be considered as apparent – due to the fact that the guideline itself affirms the relevance of the personalization of programs and courses in respect with the students background – the

generalized scarce adherence by the eight curricula afferent to the class 100/S to the IS Core Courses block, induces to consider as not appropriate their assimilation to a MSIS06 compliant program. The IS Core block actually includes a set of courses providing the core of both technical and managerial competence in IS. In coherence with what is recommended in the MSIS06 model, also the Italian curricula offer a set of courses focused on specific topics such as for instance network architecture and wireless systems. These curricula also reserve some courses for data mining and data warehousing topics, and more specifically to models and methods for the decisional support as well as aspects related to the artificial intelligence as robotics and neural networks. Nevertheless a lack in courses focused on system analysis and design process, or on enterprise modeling is detectable. A sole curricula is, actually, concentrated on this body of knowledge including courses in IS Design, in Computer Interface Design and a laboratory on the design of multimedia applications. These curricula also include another course in Enterprise Modeling focused on innovative organizational models and ERP. Supply Chain Management and CRM are then the topics of two courses included in another program.

From a transversal analysis on the courses that may be included in this area, the tendency in the Italian programs is to concentrate on specific instruments and on their functioning at the cost of a more systemic view, oriented to promote and stimulate the critical evaluation of technologies in respect of their real and potential impacts on business. This observation is also confirmed by the scarce presence of courses related to the IS Management topics. A course in Project Management is included in only three programs, in one of which among of the predefined optional ones; moreover only in two programs, offered by the same university, a course in IS Strategy and Policy is included.

Furthermore, in no programs there are courses with distinctive objectives and characteristics peculiar of an Integrated Capstone aiming to integrate different components of IS learned in the IS core, even if five out of the eight programs reserve between 8 and 12 credits (out of the provisioned 120) for a stage experience. This may be exploited to strength, through an empirical experience on a real problem, the competences acquired along the educational program. More attention, instead, is reserved to ethical and legal implications of digitization: the 50% of programs include a course concerning legal implications, while another includes a course on the sociological implication of the Information Society.

For what concern the Career track, as elective curricula that may be variously activated by individual institution in respect with the available resources and detected needs, the more relevant aspects in this sense are represented by the presence in two different curricula, actually offered by the same university, of three different educational paths selectable by the attendant students at the beginning of the program. The heavy juridical, economical or technological nature of these profile, indeed composed by several courses in the specific discipline but not in IS, induces to conclude that the primary tendency of the overall eight observed programs is to combine together in a quite fragmented and scarcely integrated way, knowledge and skills coming from different disciplines.

Conclusion

The wide heterogeneity in the eight curricula considered hinders to perform a general and comprehensive evaluation. Actually the curricula span from programs with a structure and topics more typical of a MS in management to programs with some orientations to the Management in IS.

Anyway a general consideration that seems to be valid for large part of the programs is the shortage of courses peculiar of the IS discipline. Actually, assuming for the IS domain the definition provided in [3 p.10], large part of the courses may not be considered as representative for the IS discipline, having rather a strong connotation or in business and economics or in computer science. In particular, in the case of courses in computer science, the technical knowledge and skills on the design and development of systems and architectures are privileged to the knowledge, methodologies and open issues related to their adoption and management. This fragmentation can be partly justified by the tendency to borrow courses already activated in other faculties and with a different objective and partly justified by the presence of difficulties by many academics in considering IS as a correlated but independent discipline.

As a final conclusion, even if no definitive considerations were achieved, in the authors' opinion the more relevant value of this paper is in the picture captured of the trend and the actual provision of programs and courses in IS by the Italian faculties of economics. Actually, whereas several efforts still need to be spent, the ITAIS07 conference represents a great opportunity to revive the debate on the IS curricula in Italy and to collect suggestions and hints for the further work to be done for a more comprehensive investigation, aiming also at identifying possible direction for future actions in the Italian academia.

References

1. Benamati, S. and Mahaney, R. (2004). The future job market for IS Graduates. Proceedings of the 10th American Conference on Information Systems, New York, August 2004
2. Galletta, D. (section editor), Graduate IS Programs (Masters Level), IS World Net, 2007, URL: http://www.aisworld.org/isprograms/graduate/graduatealphabetic.asp
3. Gorgone, J.T., Davis, G.B., Valacich, J.S., Topi, H., Feinstein, D.L., and Longenecker, H.E. Jr. (2002). IS 2002, Model curriculum and guidelines for undergraduate degree programs in Information Systems. Association for Computing Machinery (ACM), Association For Information Systems (AIS), Association for Information Technology Professionals (AITP)
4. Pontiggia, A., Ciborra, C.U., Ferrari, D., Grauer, M., Kautz, K., Martinez, M., and Sieber, S. (2003). Panel: Teaching information systems today: The convergence between IS and organization theory. Proceedings of the11th European Conference on Information Systems, ECIS 2003. Naples, Italy
5. Benbasat, I. and Zmud, R. (2003). The identity crisis within the IS discipline: Defining and communicating the discipline's core properties. *MIS Quarterly*. Vol. 27(2), 183–194
6. Gorgone, J.T., Gray, P., Stohr, E., Valacich, J.S., and Wigand, R.T. (2006). MSIS 2006: Model curriculum and guidelines for graduate degree programs in Information Systems. *Communication of the Association for Information Systems*. Vol. 17, 1–56

Human–Computer Interaction and Systems Security: An Organisational Appraisal

M. Cavallari

Abstract The motivation of the current paper is the search for responses about decision making in both context, computer and non-computer scenarios, thus whether no difference shall be found, the large behavioural literature on non-computer decision making can be used to interpret security issues. The effort is then devoted to identify organisational theoretical domains in order to approach the security problems. In particular it is identified a set of organisational literature contribution to emerging forms of organisations and behaviours with respect to the human factor and security problems [1–5]. While many authors propose a top-down view of organisational/policy-directed security the proposition of this paper is a bottom-up analysis, addressed to the end-user as a member of the organisation and moreover of its culture. As the results of the work, a threefold set of theoretical frameworks has been identified, leading to a robust conceptual base: the *"Contingency Model of Strategic Risk Taking"* of Baird [2]; the *"Strategic modeling technique for information security risk assessment"* of Misra [4], and a major contribution of Ciborra's work [3, 6, 7].

The Problem

Within organisations of any nature, both large one as well as small business, government or education, pervasiveness of networked computing and interconnections between information systems, determines a substantial variety of situations in which human–computer interaction that can put systems at risk. While technical security is taken care of with effort and skilled staff, the grey shadow of systems security that rely on human–computer interaction is less in depth taken care of and users often think that computer security is very little of their concern. The motivation of the current paper is, first and as a prerequisite, the search for responses about decision making in both context, computer and non-computer scenarios, thus whether

Università Cattolica del Sacro Cuore, Milano, Italy, maurizio.cavallari@unicatt.it

no difference shall be found, the large behavioural literature on non-computer decision making can be used to interpret the security issues with respects to the end-user (e-u) side. The effort is then devoted to identify organisational theoretical domains in order to approach the security problems dealing with HCI within those frameworks. Analysts and researchers have illustrated and demonstrated on an empirical base that computer-security situations in which users can put systems security at risk – while this would be for the entire system or a substantial part of it is irrelevant, as partially compromised systems soon become entirely compromised [8] – occur on a daily basis [1, 9] and in the same perspective there are a number of specific technological survey of systems violations, [10] et altrii. Those e-u decisions often seem small and routine ones, but as well they might conceal a high potential of risk that can lead to major security threats.

Commentators and computer security experts agree to differentiate risks and threats [11, 12], where risk is the probability of an event, and threat is the potential harm which can spring from that risk. Considering risk in relation with associated threat within organisation would go beyond the scope of the present work, thus it is a relationship which should be taken into account and that can constitute a suggestion for further investigation. We would use the concept of "risk" such as it would be always associated with a "threat". This notion is particularly important with respect to social engineering techniques subtly used to compromise most of the systems. Within the loose boundaries of "human–computer interaction" it is particularly significant, in the opinion of some authors, to which we adhere, the particular situation of computer security that involves an action or decision directly from the user is open to "unpredictable" risk, even a massive risk for the whole system [8, 13–15]. Therefore, understanding how users perceive risk and make security decisions, when it comes to their turn, is of great importance in order to understand organisational security issues and the impact on information systems of user interaction.

Scope of the Work

The aim of the work is to verify if there are the conceptual conditions to take advantage of theoretical frameworks of organisational studies to help understand computer system security issues within an organisational perspective.

Often in technical literature user interaction security is identified with encryption of data and access credentials. Numerous authors have demonstrated that cryptographic perspectives of data security are far from making the interaction between data and the organisation (and users) the perfect match [16–18]. Some studies show that there is an "emotional" aspect within the relationship of human–computer interaction, for which users "need to believe" what the computer tell them: if they weren't, work would then be too hard to handle and it would soon become unbearable by most people [19], a great organisational issue is then arising: *security*.

Authors like Baskerville and Anderson propose an approach starting from the observation that risk is one of the less understood aspect in user's organizational life and behaviour [16–18, 20, 21].

The risk is well took into account when it is immediate, but is has been observed that users too often don't understand the associated subtle threats, while they may well generally perceive risk [10]. Recent investigations focus on security decisions-making and search empirical evidence that link security decisions and the factors that influence likely action, concluding that altering end-user security warnings it is possible to improve systems security, through the intervention on the design of the human interface [22]. Though the results of those studies are incomplete as they miss, on one hand, empirical investigation into the effectiveness of the re-designed security warnings and, on the other hand, they leave unexplored the reflections of fundamental organisational issues in not considering the individuals from a systemic point of view [20, 21]. The mentioned results [22] demonstrate that computer related decisions process is no different from non-computer related one. It is then possible to utilise and take advantage of the large behavioural literature about non-computer decision making. This seem to be a major contribution. Within the present work there is the search for a theoretical supported approach to the way the risk is perceived and handled by humans and particularly by users in organisations [1, 3]. In particular it is identified a set of organisational literature contribution to emerging forms of organisations and behaviours with respect to the human factor and security [2–7].

Decision Making and Technology Usage

In recent studies about decision making and technology, a broad investigation has been made about computer and non-computer different scenarios, in order to perceive how risk and gain-to-loss ratio might affect decisions in both situations.

Hardee shows results that consider qualitative comments to determine which variables were taken into account during the decision making process [22, 23]. Findings of the study show that the most conservative decisions are made when there is a clear perception that the risk is high, but important to notice, participant's perception of gain-to-loss ratio has shown to be fundamental while decisions were taken. In particular conservative decisions were adopted when the losses where perceived greater or equal to the risk. Hardee suggests to take into account security warnings whilst developing software user interfaces, in order to embed explicit text that identify highly risky decisions and the resulting possible outcome as well as pointing out the greater potential for losses.

This approach suggest interesting key-points about the nature of decisions, which tend to coincide between computer and non-computer scenarios, but suffer, in the opinion of the author of the work, of a great focus on a predominant factor, i.e. the user-side interface and the warnings about potential losses, rather then in appropriate design and proper organisation.

The most important outcome and contribution of the mentioned study, with respect to the scope of the present work, is the interesting finding that there is no difference between computer and non-computer decisions where risk and gain-to-loss ratio are held constant [22, 23]. This aspect shall lead, as well, to more profound research in the field.

End-User Behaviour and Security

End-users (e-u) are often pointed out as the "weakest link" in system security, because they might compromise entire systems, falling victims of social engineering and ignoring much of technology issues and security polices. This vision is rather unconstructive and, on the contrary, end users can become, in our opinion, an important asset of the security of systems, from an organisational point of view.

In literature it is possible to notice a paradigm shift about Human–Computer Interaction (HCI) and security. HCI focus on individuals while security as a whole is concerned with the entire organisation, not only the information system. For task-oriented problems this distance is not particularly relevant. The rationalist-functionalist paradigm derived from March and Simon [24] might suggest that an individual is a simple component in a broad range information system. Functionalism is far behind modern conceptions of organisations and therefore with the correspondent information systems. Management information systems study is much about the functioning of an organisation, but security is very little about task-oriented. The major qualities of task are both goal oriented, within time and activity constraints. System security does not show those properties. Security management is a high level objective, nothing to do with goal-oriented and it is a continuing process and has no time boundaries. If it is true that end-user and in particular, certain kind of end-user behaviours, may represent the weakest link of the system security chain, thus is appropriate to investigate the problem in search of a framework of reference, both as an individual and an organisational issue. Many authors propose a top-down view of organisational/policy-directed security [1, 14, 25]; but our proposition of further analysis is bottom-up, addressed to the end-user as a member of the organisation and moreover of its [3, 5, 26].

Conclusion

As the results of our work, a set of theoretical frameworks has been identified, leading to a robust conceptual base while approaching systems security and HCI, in an organisational view.

Contingency Model of Strategic Risk Taking

First and foremost a solid theoretical framework can be found in the "Contingency Model of Strategic Risk Taking" [2], originally not proposed as to be applied to systems security problems, where basic principles of coping with complex risk taking decisions by organisations. The study identifies a set of fundamental variables and relates those into the proposed framework with the nature of the relationship between the variables referring to the individuals and the risk taking behaviour, moreover with the interaction between multiple variables and the level of risk

adversity/risk awareness. The Contingency Model is summarised by the following formal representation: Rs = Er + Ir + Or + Pr + Dmr, where: Rs = Strategic Risk Taking; Er = General Environmental Risk Indicators; Ir = Industry Risk I.; Or = Organisational Risk I.; Pr = Problem Risk I.; DMr = Decision Maker Risk I. As we can assume we can take advantage of solid literature from non-computer decision making, further development for research could be derived from the model, verifying empirical evidences of adaptation.

Strategic Modeling Technique for Information Security Risk Assessment

The second theoretical framework which can be adopted in evaluating HCI security problems and decision making is the impeccable work of Misra [4], the *"Strategic modeling technique for information security risk assessment"*.

The proposed modelling technique is particularly useful and valuable because it proposes a new conceptual modelling approach, by considering and evaluating in a systemic view, the strategic dependencies between the actors of a system and analyzing the motivations and the interrelations behind the different entities and activities which characterise that system. The model identifies a set of *Security risk components* and consequently, defines the *Risk management process*. The valuable and the re-usability of the model relies in its new technique for modelling security risk analysis using the concept of actor-dependency, but even more consistent appears the extension of its scope to the domain of security risk assessment in information systems. This can be of great help within the research of organisational studies. Thus the modeling approach suffers of some limitations such as the fact that the proposed model cannot be used while implementing existing systems, but can be of aid only in the designing phase, the proposed model constitutes a milestone in the field.

The Contribution of Ciborra's Work

Within the scope of the present work it is possible to identify a way in which organisational studies of Claudio Ciborra [3, 6, 7] can help to describe and offer a theoretical framework for understanding the organisational impact of information systems security threats. With respect to Ciborra's work and theories we can find a numerous aspects and definitions which can be adopted and utilised to understand the organisational aspects of security and HCI. In particular the speculation about the following concepts is particular fruitful:

- "Krisis". It is clearly argued that while approaching the advances in technologies and business applications had been ignored by MIS research, and it is demonstrated that it would have been impossible to develop those systems using classical IS development methods. This is directly applying to information systems security, taking advantage of Ciborra's pointing to the weaknesses of the

approaches and the suggestion to opt either for the ideal, or for the real. Linux development is a clear demonstration of Krisis.

- "Bricolage" systems security is much influenced by corporate culture. As Ciborra clearly stands, major trends in business, as well as responses to environmental variables (such as information security threats) are rarely dealt with in MIS research, and if they are it is often too late for the insights to be relevant. As Ciborra demonstrates, well known examples of successful strategic systems developments were never intended to be of strategic importance. The Information Security System can be seen as a strategic application and with no doubt it is a component of the competitive strategy of the organisations. To avoid easy imitation strategic applications must be based on intangible and opaque areas of organisational culture, and security follows into that line. Since strategy is difficult to plan, competitive advantages spring out from exploitation of intangible characteristic and innovative capabilities. Companies make strategy through "bricolage" and improvisation in order to overcome the cognitive barriers that stand in the way of innovation. And a strong process of innovation is required by security threats and needs. Strong security systems and fail-save solutions in the real world of organisations are highly innovative and original. Standard solutions (which present "security" as a product) tend to be very weak and behind a major security failure there is always a "standard" product or "standard" solution.

The present work argues that we should we take advantage of the evolutionary approach of "bricolage" concept, i.e. a highly situated, experience-based, competent improvisation, with respect of information systems security organisational issues. As a hint for further study it is very challenging the perspective to investigate the apparent contradiction of the structured, top-down process of systems security design and Ciborra's position about the limited success of methodologies due to, normally, weak and inflexible corporate strategy.

Combining the several contribution and solid base frameworks in organisational studies and non-computer decision making can lead to an extremely powerful set of conceptual tools in analysing and interpreting security problems within organisations and HCI, with a systemic view. Further research could approach and verify the hypothesis formulated with empirical evidences and collected data.

References

1. Adams, A. and Blandford, A. (2005). Bridging the gap between organizational and user perspectives of security in the clinical domain. *International Journal of Human–Computer Studies*, 63, 175–202
2. Baird, I. S. and Thomas, H. (1985). Toward a contingency model of strategic risk taking. *Academy of Management Review*, 10(2), 230–245
3. Ciborra, C. (2004). The Labyrints of Information, Oxford University Press, Oxford, UK
4. Misra, S. C., Kumar, V., and Kumar, U. (2007). A Strategic modeling technique for information security risk assessment. *Information Management & Computer Security*, 15(1), 64–77

5. Orlikowski, W. J. (2000). Using technology and constituting structures: A practice lens for studying technology in organizations. *Organization Science*, 11(4), 404–428
6. Ciborra, C. (1993). Teams Markets and Systems, Cambridge University Press, Cambridge, UK
7. Ciborra, C. (2000). From Control to Drift, Oxford University Press, Oxford, UK
8. Dourish, P., Grinter, R. E., Delgado de la Flor, J., and Joseph, M. (2004). Security in the wild: User strategies for managing security as an everyday, practical problem. *Personal Ubiquitous Computing*, 8(6), 391–401
9. Sasse, M. A., Brostoff, S., and Weirich, D. (2001). Transforming the 'weakest link' – a human/computer interaction approach to usable and effective security. *BT Technology Journal*, 19(3), 122–131
10. Jensen, C., Potts, C., and Jensen, C. (2005). Privacy practices of Internet users: Self-reports versus observed behaviour. *International Journal of Human–Computer Studies*, 63, 203–227
11. Mitnick, K. D. (2003). The Art of Deception, Wiley, New York
12. Schneier, B. (2006). Beyond Fear, Thinking Sensibly About Security in an Uncertain World, Wiley, NY
13. Karat, C.-M. (1989). Iterative usability testing of a security application. Proceedings of the Human Factors Society, Denver, Colorado, 273–277
14. Karat, J., Karat, C.-M., Brodie, C., and Feng, J. (2005). Privacy in information technology: Designing to enable privacy policy management in organizations. *International Journal of Human–Computer Studies*, 63, 153–174
15. Roth, V., Straub, T., and Richter, K. (2005). Security and usability engineering with particular attention to electronic mail. *International Journal of Human–Computer Studies*, 63, 51–63
16. Anderson, R. (2001), Security Engineering: A comprehensive Guide to Building Dependable Distributed Systems, Wiley, New York
17. Anderson, R. (1993). Why cryptosystems fail. Conference on Computer and Communications Security, Proceedings of the 1st ACM Conference on Computer and communications security, 215–227
18. Anderson, R. (2001). Why information security is hard: An economic perspective. Seventeenth Computer Security Application Conference, 358–365
19. Gallino, L. (1984). *Mente, comportamento e intelligenza artificiale*, Comunità, Milano
20. Baskerville, R. (1993). Research notes: Research directions in information systems security. *International Journal of Information Management*, 7(3), 385–387
21. Baskerville, R. (1995). The Second Order Security Dilemma, Information Technology and Changes in Organizational Work. Chapman and Hall, London
22. Hardee, J. B., Mayhorn, C. B., and West, R. T. (2006). To download or not to download: An examination of computer decision making, interactions. *Special Issue on HCI & Security*, May–June, 32–37
23. Hardee, J. B., Mayhorn, C. B., and West, R. T. (2001). You downloaded WHAT? Computer-based security decisions. 50th Annual Meeting of the Human Factors and Ergonomics Society. Santa Monica, CA
24. March, J. G. and Simon, H. A. (1958). Organizations. Wiley, New York, NY
25. Dhamija, R. (2006). Why phishing works. Proceedings of CHI, Montreal, Quebec, Canada, 581–590
26. Schultz, E. E., Proctor, R. W., Lien, M. C., and Salvendy, G. (2001). Usability and security: An appraisal of security issues in information security methods. *Computers and Security*, 20(7), 620–634

E-Learning: Role and Opportunities in Adult Education

A.G. Marinelli and M.R. Di Renzo

Abstract The development and diffusion of e-learning tools and technology has deeply changed the opportunities for adult education. Originally, a great emphasis was placed on the methodological potentialities provided by the technology, considered as able to substitute other educational methods. Later, it emerged the need to analyze the technological opportunities of ICT in a multi-disciplinary setting, with the creation of educational strategies based on the integration of a wider range of available methodologies (the "blended" approach). This work tries to understand and analyze, by examining an actual case of adult education, the real advantages that e-learning can offer to those who participate in learning programs for the development of managerial skills.

Introduction

In the current economic and organizational environment, people are the main determinants of the competitive advantage for organizations: in fact, they can acquire such properties, with their own competences, to become firm specific for the organization itself [1]. Today, the life cycle of competences is more restricted. As they became shortly old, the ability to update and develop them quickly and with quality becomes a strategic competence. In particular, the existing organizations require specific competences – including the ability to think strategically, to understand and react to the changing scenarios, to take decisions under uncertainty, to negotiate and manage conflicts, to commissioning, and to lead team working – at all hierarchical levels but above all at that levels that require a specific responsibility. Education, defined as a deep and global intervention that creates relevant changes in the human intellectual development [2], can be an effective tool to acquire and develop those competencies. In fact, through appropriate educational methodologies, it fulfils the learning processes that, if well managed, change human behaviour, enhancing better

Università LUISS – Guido Carli, Roma, Italy, agmarinelli@luiss.it, mrdirenzo@luiss.it

professional performances and the goals achievement. The changes that shape current organizations have created new educational needs. In fact, there is an increasing claim for a less expensive education (with few face to face meetings), just in time and just enough, able to quickly implement theory in professional practice, in job activities needs, attributes and individual lacks [3]. As a consequence of the drawbacks of traditional learning methodologies, e-learning is gaining momentum, since it allows to overcome the limits of time and space and to design self paced learning processes. It also eases the creation of learning sources, which can be more useful to students' needs [4]. Recent studies suggest that traditional classrooms coexist with virtual ones. In particular, the current debate on education processes is focusing the understanding of the learning methodologies more effective in adult education. The present work aims at facing this debate, analysing – by examining the case of an executive Master in Business Administration's classroom of one of the Italian leading business school – the real advantages that e-learning can offer to those who participate in learning opportunities for the development of managerial skills.

Learning Models in Adult Education

In literature many authors label educational methods as *passive methods*, based on the behaviourism [5], and *active methods*, based on the cognitivism and constructivism [6]. Passive methods are based on a linear approach, with a considerable distance between the teacher and the students: the learner is passive, he only has to listen and pay attention. The classic example is the classroom lesson. Active methods, instead, are based on a cyclic approach in which the interaction between the teacher and the student promotes debates and discussions; instructional methods used are simulations, mentoring, exercises and experiments (*try and error method*), actual and not unreal problems are studied, discussion and reasoning are promoted; it is a learning method based on problem solving technique. Many authors suggest that learning must be based on individual experiences, on how the individual interprets and creates the meaning of his/her experience. Some authors claim that the learning process, based on text and knowledge transfer from instructor, of traditional methods, must be replaced with learning by experiencing [7]: the learner's textbook should be replaced by external life [8]. Others underline the importance of motivation in learning processes as a central component of human behaviour and introduce a new concept of instructor as a learning facilitator [9]. An important contribution by Knowles, the main author of *andragogical theory*, who suggests that knowledge is more easily grasped when it is connected with experience [10]. The andragogical model is based on four main assumptions: (1) Their self-concept moves from dependency to independency or self-directedness; (2) They accumulate a set of experiences that can be used as a basis on which to build learning; (3) Their readiness to learn becomes increasingly associated with the developmental tasks of social roles; (4) Their time and curricular perspectives change from postponed to immediacy of application and from subject-centeredness to performance-centeredness [11].

Researchers, who belonged to constructivism, underline the importance of structured learning context. Such an environment must promote knowledge creation and not only its mere replication; it should face real complex situations in case studies and show the practical application of theory. Moreover it should facilitate thoughts, showing different points of view and multiple representation of reality and encourage common creation of knowledge through cooperation (communities of learning) [3]. Considering these theories in learning processes' planning is vital for the success of learning itself and, besides, it can reduce the risk of the phenomenon scientists name *plateu*, i.e. the learning standstill, whose main origins lay on the drop of motivational recovery and on the shortcoming of the traditional learning methods [12].

Benefits and Drawbacks of On-line Learning

The growing importance of *life long learning* and the features of adult education have founded in e-learning an important and useful tool. E-learning can be defined as the "use of Information and Communication Technology to support education/learning processes based on the on-line content and the use of shared bases of knowledge, on active and/or cooperating learning" [13]. However, it must be pointed out that this learning instrument must not be considered a mere technological tool, it rather is a real methodology that requires remarkable changes in teaching and learning methods. It must be argued, therefore, that learning improvement relies not on the technology itself but on the way it is used [14]. The main benefits of technology-based learning that researchers have identified are the deep flexibility of time and place, the improvement of education access, the increase of education content quality, its more flexible administration, the opportunity of easily measuring the results, the availability of simulation tools, and the decreasing of costs. Evans and Fan, in particular, list three main advantages to e-learning: (1) the opportunity of self-defining the learning location; (2) the opportunity of determining the time of learning; (3) the opportunity of setting the individual pace of study, organizing one own learning schedules according to one's personal set of knowledge and to professional and personal agenda [15]. According to the International Institute for Educational Planning, the main reasons that explain the current growth in technology use for adult education, lay on advantages such: (1) the increasing interaction between students and the relative increasing of its flexibility through the use of e-mail and discussion forums; (2) the opportunity of combining text, graphics and multimedia resources to create a wide range of educational applications; (3) the opportunity of international, cross-cultural, and collaborative learning. Given those assumptions, we pose the question whether it is possible to consider e-learning as a more effective educational methodology rather than the traditional classroom. According to literature, not everybody agree with this statement and many are the drawbacks. In fact, not only it is necessary that students hold the appropriate technological skills, but also self regulation competences. The latter are particularly necessary

when the e-learning platform works in asynchronous mode [16, 17]. Moreover some authors [18, 19] suggest that e-learning reduces or even eliminates the interaction amongst both students and instructors, creating feelings of isolation. The majority of online courses still adopt an asynchronous approach to learning, limiting the amount and depth of interaction and increasing moments of distractions. An important issue often ignored, but central in distance learning, is the need – for tutors and instructors – to change the teaching practices, shifting from the role of *content provider* to *content facilitator* [20]. The learner should be considered other than a mere "recipient to be filled" [21] and the teacher should awake his/her inclination for knowledge. Many researchers prefer the blended approach [22], that combine face to face and distance lessons, moments of learning *self-paced* and *instructor-led*. In this way, the right timing of the learning process could be matched with the flexibility in both teaching and learning. The opportunity of mixing different educational methodologies, trough the use of traditional and innovative learning tool, enable to fit the requirements of students and organizations more effectively.

Empirical Study

Sample

The study has been conducted on a class of an Executive Master in Business Administration organized by a prestigious Italian Business School. The aula is composed of 40 master participants, 35 years old on the average, 28% of them has an economic education, 27% are engineers, 7% comes from the faculty of biology and 14% from law; finally 24% are graduated in medicine, psychology, statistics, math and communication science. Besides, 17% work in the telecommunication industry, 17% in services, 12% in energy, 12% in chemical-pharmaceutical sector, 10% work in electronics, aerospace, legal and private sector, 10% come from infrastructures, 7% from banking and finally 5% from the industries of tobacco, consulting and petrochemical. The average job experience is of 10 years. Focusing on the organizational functions the main figures lay are commercial, production, management and audit.

Course Design

The part time program is delivered in a blended formula during the week-ends combining face to face classes, through meetings, seminars, and traditional lessons, with distance sessions supported by a platform and other innovative methodologies, stretching a period of 16 months. The course has a modular structure, with eight core courses and four electives. The core courses aim at developing competences, knowledge, analytical and planning tools, and also the techniques and the methodologies to evaluate, lead and solve complex problems in a systemic and advanced perspective. The electives give the opportunity to study in depth some specific dimensions of management.

E-learning Platform

Each student has access to the e-learning platform through Internet, using his username and his password. When entering, there is the "User Home" where there are the course modules and three items: technical support, change the password, and logout. When clicking on the course module, a window appears in which there are the links to these functions:

- *Home Page* link (to come back to the list of courses)
- *Course objectives*
- *Course content* (introduction, map, sections, lectures, activities, tests, self-evaluations, exc.)
- *Glossary*

Inside the course content, there are the introduction, with the aim of showing the themes that will be discussed during the face to face lessons; the map, that shows in a single table the learning objects (sections, lectures, activities, tests) of each module; the sections that compose each module. The sections are the learning units or the Learning Object that, joint together, compose the learning module, the course and the master. Each section of variable length contains not only text but also diagrams, tables, images, to facilitate the comprehension of the course content. In the sections there are links to lectures (in pdf format) and to external websites. The platform enables the student to make exercises, to apply in practice what they have learned. Moreover, when entering in each course module it is possible to have access to some community technologies that promote a collaborative learning. Among these, the forum has a central role because each student can add new discussion topics or new comments, the chat can be used to promote knowledge sharing among student, and the *wiki* that is a virtual library that contains downloadable files.

Research Method

The research methodology used to analyse the role of e-learning in adult education is based on the study of the interactions between three variables:

1. Independent variables, referring to student profile (attendance, age, job experience/age, job experience/role, education)
2. Dependent variable, which is the performance of each student, represented by the average of the marks obtained in the final exams of each core course
3. Mediation variables, that describe the use of e-learning platform and are represented by three dimensions: the number of accesses, the number of self-evaluation and tests made, and the number of forum discussions

This model analyses the impact of the independent variables on dependent variable, both directly and mediated by the using of platform. This work in progress has been supported by a survey, with the aim of analysing the student perception of platform efficacy in learning process. The data are drawn from an on-line questionnaire of

twelve close items (*multiple choice* or true/false). The percentage of response is about 87%. Results show that about 40% of students hasn't ever attended an on-line course before. The satisfaction of e-learning platform, in terms of quality, hasn't been completely positive, 47% have affirmed to be not much or not at all satisfied; nevertheless more than 50% believe to have been facilitated by the platform use. Referring to the item that measures the evaluation of the opportunity of substitute traditional with on-line lessons, 93% of students disagree because of the limits of interpersonal communication and the difficulties of interaction among both students and teachers. This result has been confirmed by data that shows that only 7% are satisfied by the utility of interactions that took place in forums and in chat among the component of EMBA network. Nevertheless, about 33% of students assert to feel a member of a virtual learning community and among these, more than 40% consider the community as an important facilitator of the learning process. More than 53% of students state to have studied on platform less than 5 h per week and more than 70% do it because they are led by tutors.

Conclusion and Future Aims

Although we are not able to draw strong evidences of the advantages and disadvantages of e-learning in adult learning processes, however, our work allows to enlighten some preliminary conclusions:

> the main advantage of on-line learning is the chance to create virtual communities that facilitate learning, increasing the enthusiasm of students, that feel members of a team, and facilitating the knowledge sharing (tacit knowledge), which is otherwise difficult to transfer:

- The main drawback of e-learning platform is the decreasing of interaction in on-line environment, in terms of quickness and spontaneity, typical of the face to face communication.

Further research will elaborate more these results, studying the interactions existing between the variables of the model shown before. In this way, we will obtain more meaningful results: about the advantages that technology can offer to adult education.

References

1. Barney, J. B. (1996). The resource-based theory of the firm. Organization Science. 7(5), 469
2. Goguelin, P., Cavozzi, J., and Dubost, J. (1972). Enriquez La formazione psicosociale nelle organizzazioni. Isedi, Milano
3. Marinensi, G. (2002). Corporate e-learning. La sfida della qualità. Linf@Vivere digitale
4. Caramazza, M., Galluzzi, R., Godio, C., Nastri, A., Quaratino, L., and Serio, L. (2006). Profili professionali e competenze emergenti nel settore Telecomunicazioni. Quaderno pubblicato nell'ambito del progetto, Format TLC formazione Manageriale e Tecnologica

5. Skinner, B. F. (1954). The science of learning and the art of teaching. Harward Educational Review. 24, 86–97
6. Jonassen, D. H. (1994). Thinking technology, toward a constructivistic design model. Educational technology. 34(4), 34–37
7. Dewey, J. (1953). *Esperienza e educazione*. La nuova Italia, Firenze
8. Lindeman, E. C. (1961). The Meaning of Adult Education. Harvest House, Montreal Model
9. Rogers, C. R. (1970). La terapia centrata sul cliente: teoria e ricerca. Martinelli, Firenze
10. Trentin, G. (2004). E-learning e sue linee di evoluzione. Atti del primo Forum Regionale su 'E-learning ed evoluzione', Udine
11. Knowles, G. M. (1984). The Adult Learner: A Neglected Species, Golf Publishing Company, Houston
12. Fontana, F. (1994). *Lo sviluppo del personale*. G. Giappichelli Editore, Torino
13. Trentin, G. (2006). Integrando e-learning e knowledge management/sharing, CNR – ITD. http://images.1-to-x.com/elrn/452.pdf
14. Cáliz, C. and Sieber, S. (2003). E-Learning: Designing New Business Education, ECIS
15. Gabriellini, S. (2003). L'e-learning: una metodologia per il "long life learning". http://www.fondazionecrui.it
16. Sharp, S. (2001). E-Learning. T.H.E. Journal. 28(9), 10
17. Lozada, M. (2002). The right stuff for success. Techniques: Connecting Education & Careers. 77(4), 23
18. Wang, A. Y. and Newlin, M. H. (2001). Online Lectures: Benefits for the virtual classroom. O'Donoghue J., Singh G., Green C. (2004). A comparison of the advantages and disadvantages of IT based education and the implications upon students. Interactive Educational Multimedia, http://www.ub.es/multimedia/iem
19. Kruse, K. (2001). The benefits and drawbacks of e-learning. http://www.elearningguru.com/articles/art1_3.htm
20. De Vries, J. and Lim, G. (2003). Significance of Online teaching vs. Face to Face: similarities and difference
21. Sindoni, M. G., Stagno d'Alcontres, F., and Cambria, M. (2005). E-learning e il docente: il dilemma, Seminario AICLU Associazione Italiana dei Centri Linguistici Universitari, Verona
22. Calvani, A. (2004). Costruttivismo, progettazione didattica e tecnologie http://www.scform.unifi.it

Part VII
Information and Knowledge Management

D. Saccà

Managing information inside organizations is a mature discipline and practice that has been largely studied and is nowadays supported by powerful technology – and yet it does not provide adequate support to business processes of modern organizations in the era of internet and web-based scenarios, for witch flexibility is a hard requirement and does not fit the deterministic nature of traditional Information Management Systems. On the other hand, KM Systems continue to have a limited, specialized application domain despite recurrent claims on pretended revolutionary effects of some new technologies and approaches. This track will elaborate on the effective ways to tie the actionable information and knowledge to the processes and activities in organizations and on the possibilities of adding process-driven and demand-driven perspectives into traditional data-centred and content-centred views on information supply in organisations in order to incorporate organisational knowledge into information-system development processes. Through theoretical contributions, on-going researches, case studies and best practices, the track serves as a forum for researchers, practitioners, and users to exchange new ideas and experiences on the ways new systems, infrastructures and techniques (e.g., intranets, OLAP systems, service oriented architectures, data and service integration, information wrapping and extraction, data mining, process mining, business intelligence tools) may contribute to extract, represent and organize knowledge as well as to provide effective support for collaboration, communication and sharing of knowledge. Possible topics include (but are not limited to): Requirements of integrated Information and KM Systems; Structure and dynamics of organisational knowledge; From DBMS to OLAP; Integration of information sources and services; Business intelligence support in knowledge intensive processes; Designing systems and solutions to support knowledge work; Workflow and process modelling in distributed environments; Data mining; Knowledge sharing in distributed and virtual organisations; Communities of practice and KM; Emerging areas of research for Information and KM.

Università della Calabria, Arcavacata di Rende, Cosenza, Italy, sacca@unical.it
CNR - ICAR, Rende, Italy, sacca@icar.cnr.it

Adding Advanced Annotation Functionalities to an Existing Digital Library System

M. Agosti and N. Ferro

Abstract This study presents a solution to add annotation functions to an available digital library management system. The solution is based on the integration of a specialized annotation service into an existing digital library, where the annotation service supports the creation, reading and listing of annotations together with the possibility of searching for digital objects within the digital library system also making use of the content of the annotations related to them.

Introduction

Annotations are not only a way of explaining and enriching an information resource with personal observations, but also a means of transmitting and sharing ideas to improve collaborative work practices. Furthermore, annotations allow users to naturally merge and link personal contents with the information resources provided by a Digital Library Management System (DLMS).

In this paper we discuss a service oriented approach to the development of an annotation service which can be integrated into distinct DLMS. The proposed approach is based on a formal model of the annotation, which we have developed and which formalizes the main concepts concerning annotations and the relationships among annotations and annotated information resources [1]. The formal model provides us with sound bases for designing and developing an annotation service which can be easily integrated into a DLMS. Indeed, a clear definition of the concepts related to the annotation allows us to separate the functionalities needed to manage, access, and search annotations, which constitute the core of an annotation service, from the functionalities needed to integrate such annotation service into a DLMS. Finally, the formal model constitutes the necessary ground work for the working out of search algorithms and query languages with a capacity of exploiting annotations.

Università di Padova, Dipartimento di Ingegneria dell'Informazione, Padua, Italy, agosti@dei.unipd.it, ferro@dei.unipd.it

We present the integration of FAST, the Flexible Annotation Service Tool which has been conceived and developed at the Department of Information Engineering of the University of Padua [2, 3], within the DelosDLMS, a new-generation DLMS which has been developed in the context of the EU-funded project DELOS (a Network of Excellence on Digital Libraries) [4], and we show how advanced search functions based on annotations can be added to an existing DLMS.

The Conceptual Structure of an Annotation Service

Digital Library Management Systems usually offer some basic hypertext and browsing capabilities based on the available structured data, such as authors or references. But they do not normally provide users with advanced hypertext functionalities, where the information resources are linked on the basis of the semantics of their content and hypertext information retrieval functionalities are available. A relevant aspect of annotations is that they permit the construction over time of an useful hypertext [5], which relates pieces of information of personal interest, which are inserted by the final user, to the digital objects which are managed by the DLMS. In fact, the user annotations allow the creation of new relationships among existing digital objects by means of links that connect annotations together with existing objects. In addition, the hypertext between annotations and annotated objects can be exploited not only for providing alternative navigation and browsing capabilities, but also for offering advanced search functionalities, able to retrieve more and better ranked objects in response to a user query by also exploiting the annotations linked to them [4, 5].

Therefore, annotations can turn out to be an effective way of associating this kind of hypertext to a DLMS to enable the active and dynamic use of information resources. In addition, this hypertext can span and cross the boundaries of the single DLMS, if users need to interact with the information resources managed by diverse DLMS [3]. This latter possibility is quite innovative, because it offers the means for interconnecting various DLMS in a personalized and meaningful way for the end-user, and, as it has been highlighted in [6], this is a big challenge for the DLMS of the next generation. Figure 1 depicts a situation in which FAST manages the annotations that have been produced by two users and that are on documents that are managed by two DLMS.

The DelosDLMS

DelosDLMS is a prototype of the future next-generation DLMS, jointly developed by partners of the DELOS project. The goal of DelosDLMS is to combine text and audio-visual searching, to offer personalized browsing using new information visualization and relevance feedback tools, to allow retrieved information to be

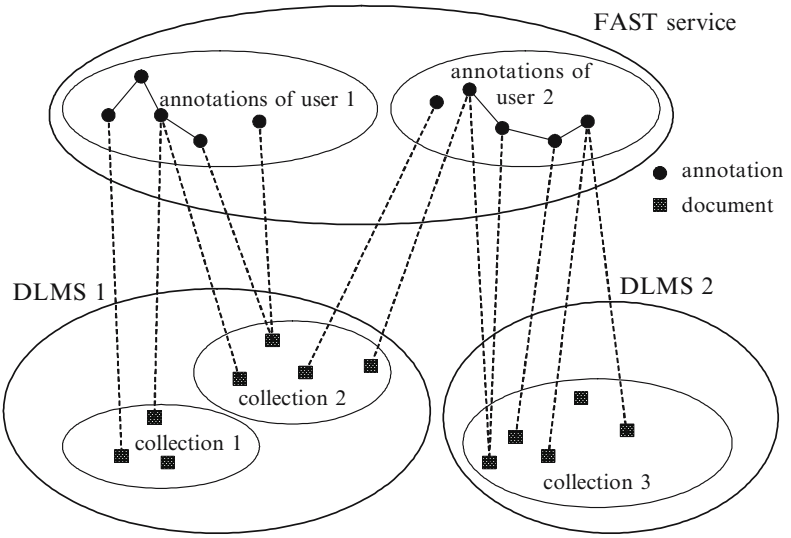


Fig. 1 Collections of users annotations managed by FAST and collections of annotated documents managed by different DLMS

annotated and processed, to integrate and process sensor data streams, and finally, from a systems engineering point of view, to be easily configured and adapted while being reliable and scalable.

The DelosDLMS prototype has been built by integrating digital library functionality provided by DELOS and non-DELOS partners into the OSIRIS/ISIS platform, a middleware environment developed by ETH Zürich and now being extended at the University of Basel. Open Service Infrastructure for Reliable and Integrated process Support (OSIRIS) has been chosen as basis for integration since it follows a service-oriented architecture and thus allows to seamlessly add more functions which are provided behind a (Web) service interface [7]. Interactive SImilarity Search (ISIS) consists of a set of DL services that are built on top of OSIRIS. The ISIS services provide content-based retrieval of images, audio and video content, and the combination of any of these media types with sophisticated text retrieval [8]. DelosDLMS has the support for content-based retrieval of 3D objects[1] and advanced audio features.[2]

FAST Architecture

FAST is a flexible system designed to support different architectural paradigms and a wide range of different DLMS. In order to achieve the desired flexibly:

[1] `http://viplab.dsi.unifi.it/research/`

[2] `http://www.ifs.tuwien.ac.at/mir/`

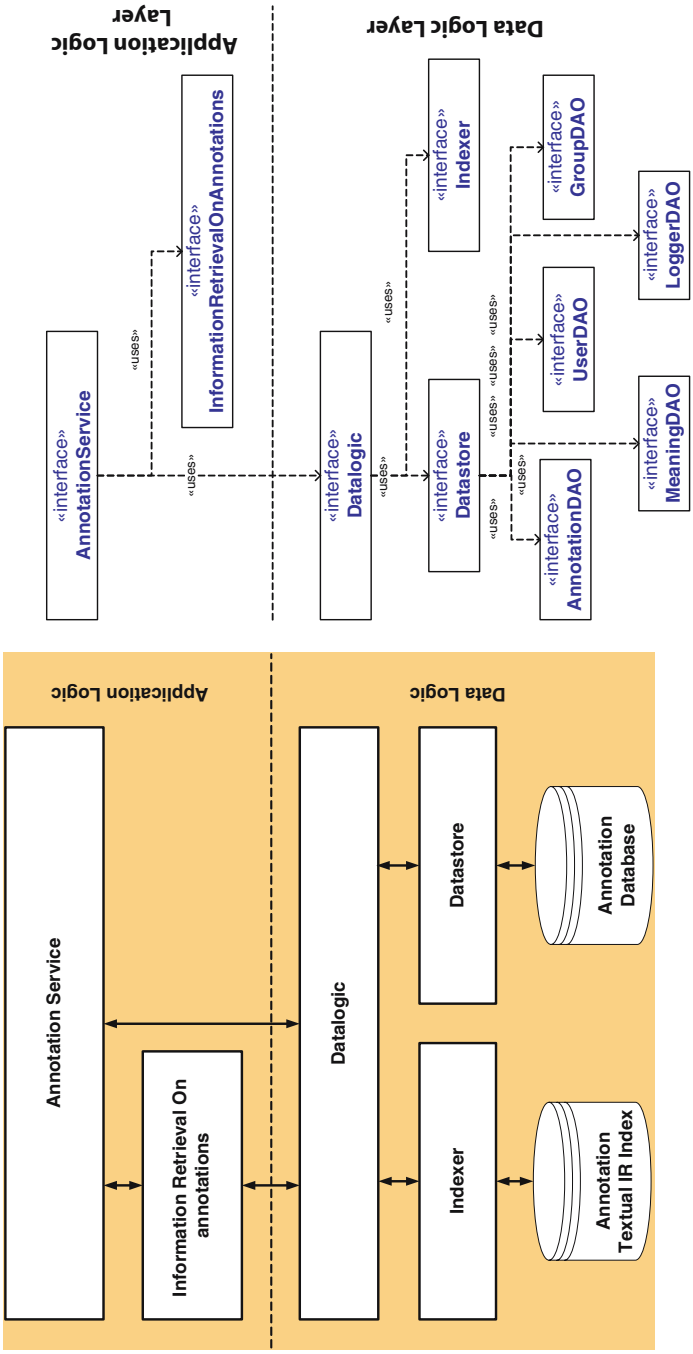


Fig. 2 Architecture of the FAST annotation service

1. FAST is a stand-alone system, i.e., it is not part of any specific DLMS
2. The core functionalities of the annotation service are separated from the functionalities needed to integrate it into different DLMS

From an architectural point of view, FAST adopts a three-layers architecture – data, application and interface logic layers – and it is designed at a high level of abstraction in terms of abstract Application Program Interfaces (API) using an object-oriented approach. In this way, we can model the behavior and the functioning of FAST without worrying about the actual implementation of each component. Different alternative implementations of each component can be provided, still keeping a coherent view of the whole architecture of the FAST system.

Figure 2 shows the architecture and the components of FAST on the left side, while on the right side the main interfaces of the system are shown. In particular, the `AnnotationService` interface represents the entry point to the core functionalities of the annotation service.

Within FAST, annotations are composite multimedia objects, where each part of the annotation, called sign of annotation, has a well-defined and explicit semantics, called meaning of annotation. Annotations can annotate multiple parts of a given digital object and can relate this annotated digital object to various other ones, if this is of interest. Furthermore, once it has been created, an annotation is considered as a first class digital object, so that it can be annotated too, as it has depicted in Fig. 1.

From a functional point of view, FAST provides annotation management functionalities, such as creation, access, and so on. Furthermore it supports collaboration among users by introducing scopes of annotation and groups of users: annotations can be private, shared or public; if an annotation is shared, different groups of users can share it with different permissions, e.g., one group can only read the annotation while another can also modify it. Note that the annotation management engine ensures that validity constraints are complied with: for example, a private annotation cannot be annotated by a public annotation otherwise there would be a scope conflict, because the author of a private annotation can be allowed to see both public and private annotations, but another user can be only allowed to see public annotations. Finally, FAST offers advanced search functionalities based on annotations by exploiting annotations as a useful context in order to search and retrieve relevant documents for a user query [9, 10]. The aim is to retrieve more documents that are relevant and to have them ranked in a way which is better than a system that does not makes use of annotations.

Integration of FAST into the DelosDLMS

The DelosDLMS supports two kinds of services: *tightly-coupled services*, i.e. services which implement the native protocol for service integration offered by OSIRIS, and *loosely-coupled services*, i.e. Web services that are integrated by using an OSIRIS component which acts as a gateway between the native OSIRIS protocol and the Simple Object Access Protocol (SOAP) protocol.

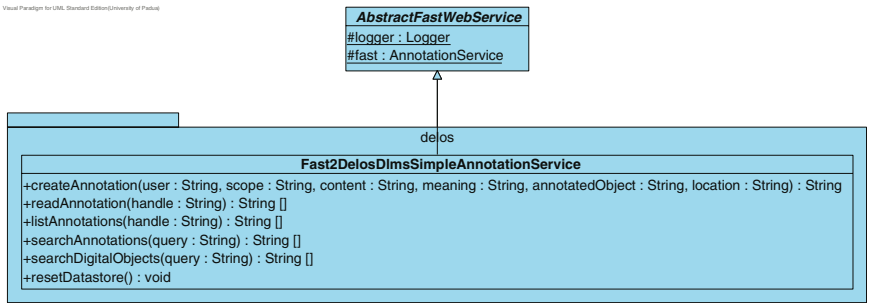


Fig. 3 UML class diagram of the designed Web service and its prototype implementation

FAST has been integrated into the DelosDLMS as a loosely-coupled service, i.e. as a Web service. First of all, the abstract class `AbstractFastWebService` has been developed. It wraps the `AnnotationService` component and provides the basic infrastructure for exposing its functionalities as a Web service; from this class, different concrete classes can be derived in order to integrate FAST as a Web service into different DLMS according to the specific characteristics of each DLMS. Secondly, the concrete class `Fast2DelosDlmsSimpleAnnotationService` has been derived from the abstract class `AbstractFastWebService` in order to provide basic annotation functionalities to the DelosDLMS.

Figure 3 depicts the Unified Modeling Language (UML) class diagram of the designed Web service where the functionalities made available are shown together with their input and output parameters. The functionalities made available by the developed Web service are:

- `createAnnotation`: Creates a new annotation, assuming that the annotation is constituted by only one textual sign and can be either public or private. In addition, a specific location of the annotated digital object can be specified, e.g. the upper left corner of an image
- `readAnnotation`: Reads an existing annotation with all related information
- `listAnnotations`: Returns a list of the annotation identifiers on a given digital object
- `searchAnnotations`: Performs a keyword-based search on the textual content of the annotations
- `searchDigitalObjects`: Performs a keyword-based search for digital objects on the basis of the content of their annotations by exploiting also the hypertext between digital objects and annotations
- `resetDatastore`: Completely resets the FAST datastore and its use is limited to the testing phase of the integration

The `Fast2DelosDlmsSimpleAnnotationService` has been implemented in Java[3] by using the Apache Axis[4] implementation of SOAP with the RPC/encoded binding style. Figure 4 shows the user interface where the results of an advanced search using annotations are reported: the grey results are retrieved using only the

[3] `http://java.sun.com/`

[4] `http://ws.apache.org/axis/`

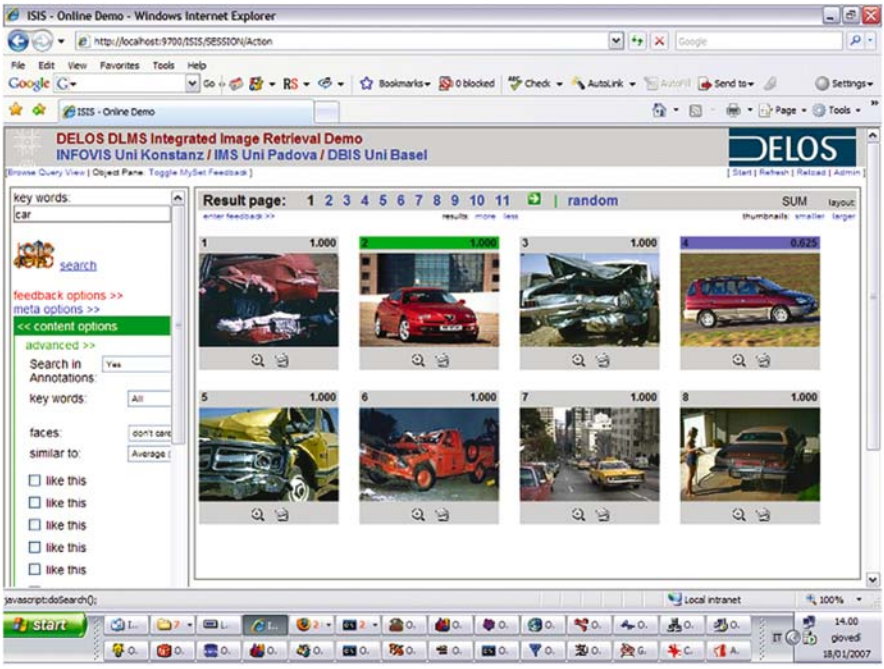


Fig. 4 DelosDLMS: advanced search functionalities based on annotations

metadata about the images; the green results are retrieved using only the annotations about the images; finally, the blue results are retrieved using both the metadata and the annotations about the images.

Conclusions

We have discussed the main features that an annotation service can offer to enhance usages of digital library systems and we have presented how the successful integration of the FAST annotation service in the DelosDLMS has been achieved.

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References

1. Agosti, M. and Ferro, N. (2008). A Formal Model of Annotations of Digital Content. *ACM Transactions on Information Systems (TOIS)*, 26(1):1–55
2. Agosti, M. and Ferro, N. (2003). Annotations: Enriching a Digital Library. In T. Koch and I. T. Sølvberg, eds., *Proceedings of the 7th European Conference on Research and*

Advanced Technology for Digital Libraries (ECDL 2003), pp. 88–100. LNCS 2769, Springer, Germany

3. Agosti, M. and Ferro, N. (2005). A System Architecture as a Support to a Flexible Annotation Service. In C. Türker, M. Agosti, and H.-J. Schek, eds., *Peer-to-Peer, Grid, and Service-Orientation in Digital Library Architectures: 6th Thematic Workshop of the EU Network of Excellence DELOS. Revised Selected Papers*, pp. 147–166. LNCS 3664, Springer, Germany
4. Agosti, M., Berretti, S., Brettlecker, G., del Bimbo, A., Ferro, N., Fuhr, N., Keim, D., Klas, C.-P., Lidy, T., Milano, D., Norrie, M., Ranaldi, P., Rauber, A., Schek, H.-J., Schreck, T., Schuldt, H., Signer, B., and Springmann, M. (2007). DelosDLMS – the Integrated DELOS Digital Library Management System. In C. Thanos, F. Borri, L. Candela, eds., *Digital Libraries: Research and Development. First International DELOS Conference. Revised Selected Papers*, pp. 36–45. Lecture Notes in Computetr Science (LNCS) 4877, Springer, Germany
5. Agosti, M., Ferro, N., Frommholz, I., and Thiel, U. (2004). Annotations in Digital Libraries and Collaboratories – Facets, Models and Usage. In R. Heery and L. Lyon, eds., *Proceedings of the 8th European Conference on Research and Advanced Technology for Digital Libraries (ECDL 2004)*, pp. 244–255. LNCS 3232, Springer, Germany
6. Ioannidis, Y., Maier, D., Abiteboul, S., Buneman, P., Davidson, S., Fox, E. A., Halevy, A., Knoblock, C., Rabitti, F., Schek, H.-J., and Weikum, G. (2005). Digital library information-technology infrastructures. *Int. J Dig Libr*, 5(4):266–274
7. Schuler, C., Schuldt, H., Türker, C., Weber, R., and Schek, H.-J. (2005). Peer-to-peer execution of (transactional) processes. *Int. J Coop Inform Syst*, 14:377–405
8. Mlivoncic, M., Schuler, C., and Türker, C. (2004). Hyperdatabase Infrastructure for Management and Search of Multimedia. In M. Agosti, H.-J. Schek, C. Türker, eds., *Digital Library Architectures: Peer-to-Peer, Grid, and Service-Orientation, Pre-proceedings of the 6th Thematic Workshop of the EU Network of Excellence DELOS*, pp. 25–36. Ed. Libreria Progetto, Italy
9. Agosti, M. and Ferro, N. (2005). Annotations as Context for Searching Documents. In F. Crestani and I. Ruthven, eds., *Proceedings of the 5th International Conference on Conceptions of Library and Information Science (Colis 5)*, pp. 155–170. LNCS 3507, Springer, Germany
10. Agosti, M. and Ferro, N. (2006). Search Strategies for Finding Annotations and Annotated Documents: the FAST Service. In H. Legind Larsen, G. Pasi, D. Ortiz-Arroyo, T. Andreasen, and H. Christiansen, eds., *Proceedings of the 7th International Conference on Flexible Query Answering Systems (FQAS 2006)*, pp. 270–281. LNAI 4027, Springer, Germany

Collaborative E-Business and Document Management: Integration of Legacy DMSS with the EBXML Environment

A. Bechini, A. Tomasi, and J. Viotto

Abstract E-business capabilities are widely considered a key requirement for many modern enterprises. New B2B technologies can enable companies all around the world to collaborate in more effective and efficient ways, regardless of their size and geographical location. The ebXML family of specifications provides a standard solution to achieve this kind of interoperability, but it is not as widespread as traditional legacy systems yet. This is especially true when speaking of document management: enterprises typically store their knowledge inside commercial Document Management Systems, which come in different technologies and handle proprietary metadata models, and are therefore highly incompatible with each other. Nonetheless, a largely agreed-upon standard exists: the ebXML Registry/Repository specification, defining both an information model and a service protocol. Ideally, perfect interoperability could be achieved by simply moving all enterprise knowledge into ebXML registries, but this is not practically feasible due to the unbearable costs in terms of time and money. In order to promote the adoption of the ebXML standard within real-world companies, some kind of system is needed to bridge the gap between existing technologies and academic standards, allowing for a smooth transition towards open formats and methods. In this paper, we propose an architecture that enables enterprises to take advantage of the power and flexibility of the ebXML approach to metadata management without affecting in-place systems, and with no need for a complete repository reconstruction. Using Web services as a universal glue, we define a modular scheme that can be used to normalize the access to enterprise knowledge by both humans and machines, yet preserving the functionality of older applications.

Università di Pisa, Pisa, Italy, a.bechini@ing.unipi.it, andrea.tomasi@iet.unipi.it, jacopo.viotto@iet.unipi.it

Business Interactions Through ebXML

ebXML (Electronic Business using eXtensible Markup Language) [1] is a suite of XML-based specifications emerging as the de-facto standard for e-business. For example, it can be proficiently used as the principal building block within information systems to support supply chain traceability [2, 3]. The specifications [4, 5] define, among other things, "an information system that securely manages any content type and the standardized metadata that describes it": the ebXML Registry. Unfortunately, only few companies adopted this relatively new standard, while the vast majority goes on using traditional Document Management Systems (DMSs). Each of them is implemented upon a different technology and follows a proprietary metadata model, leading to serious interoperability issues, as we already noticed in our introductory paper [6].

In order to promote a gradual adoption of the ebXML Registry specification, we propose an architecture that takes advantage of the power and flexibility of ebXML while leaving in-place systems unchanged. The original DMSs are coupled with an ebXML Registry, used to mirror their metadata and manage. All metadata-related operations, thus overcoming the typical restrictions of the back-end legacy module. An additional distinct component can coordinate the access to the underlying systems, and enforce metadata consistency. A direct access to the original DMS is performed only in case an actual document would be involved in the query.

From Legacy to Interoperable DMSs

A common requirement for a DMS is the ability to easily integrate with external systems, in order to provide access to enterprise knowledge from a wide variety of platforms. In spite of this, DMSs typically support a small number of applications, and little or no effort is made towards generalized interoperability (usually, they only provide a complicated and ill-documented set of APIs). This is changing thanks to the adoption of Service Oriented Architecture (SOA), but way too slowly: Web services support is provided only by the latest versions of the most popular DMSs [7–9], and the claimed support often relates to a simple framework to help develop custom services. Administrators still need to study the system's details and write the service code accordingly; furthermore, this must be done in a system-dependent fashion, since no standard way is defined for the implementation of such Web services.

The proposed solution consists of a standardized Web service interface which extends DMS capabilities. For each different DMS, a wrapper software combines system-specific APIs into logically distinct functions, and exposes them as Web services (Fig. 1). As it can be seen, our system acts as an additional access point to the DMS, leaving the original system intact. This solution lets clients free to choose between our new, technology-agnostic interface and the native interface, whenever it is either mandatory or convenient.

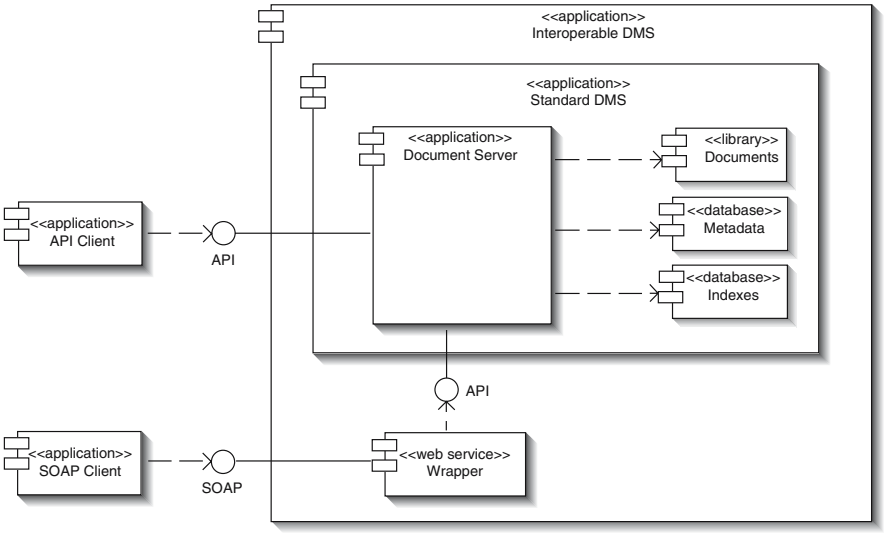


Fig. 1 Basic components of an interoperable DMS

Interface Design

In order to achieve true independence from the actual system in use, we need to set up a generic interface that can accommodate the typical needs of DMSs. Despite the similarities existing among those systems, no standard interface has been clearly stated so far for accessing a document registry/repository. Therefore, our prime concern is to outline a set of core operations that every DMS is required to support, and then standardize the way they are accessed.

As an explicit design choice, we focused on fundamental services, leaving out any platform-specific feature. Also, we didn't take into account administration functions, due to the absence of a standard treatment for access control and user management. However, this might be a significant functionality to add in future versions.

- Authentication – A classic username/password authentication.
- Document/version creation – Implies uploading the file to the repository and creating a new entry inside the metadata registry.
- Document/version editing – The process of document download (check-out), local editing, and upload of the modified copy (check-in), typically determining the creation of a new version.
- Document/version deletion – Deleting one version and all its subversions, including both physical files and database entries.
- Metadata/fulltext search – DMSs support searches over both metadata and file content.

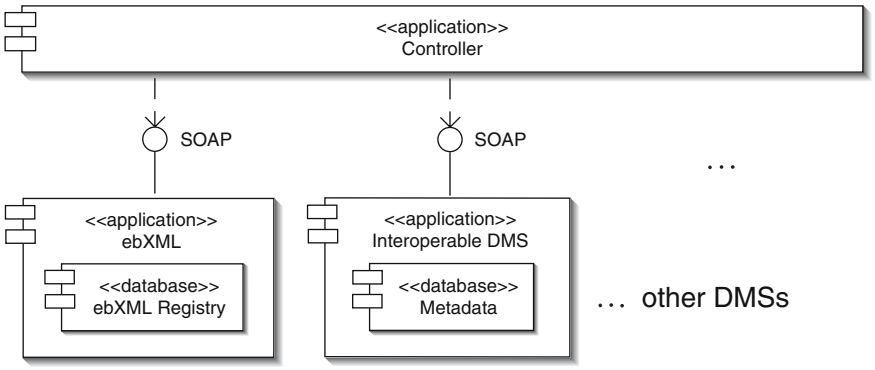


Fig. 2 Overall architecture; an ebXML Registry and several legacy DMSs connected to a controller application

System Architecture

According to our architecture, newly installed and in-place components are arranged in three sub-systems (Fig. 2).

- A legacy DMS, containing both documents and related metadata, with the added value of our interoperability component. In the general case, there could be many different systems.
- An ebXML Registry, used to store a copy of DMS metadata and provide advanced management features over legacy metadata.
- A controller application, intended to coordinate access to the above-mentioned systems.

In order to maintain the independence of each individual component, every interaction is mediated by the controller: as far as the single sub-system is concerned, no knowledge about the external world is required. It is up to the controller to compose the simple interaction functions provided by each interface into a globally meaningful and consistent operation. In particular, such software level should provide also a semantic mapping among different metadata items on distinct DMS, or maybe a mapping towards some kind of commonly established ontology.

Metadata Management

In order to be properly managed, each document must be characterized within an adequately rich metadata space. In the archive management and digital libraries community, a standardization effort has led to the definition of a basic set of metadata [10], and related harvesting protocols [11], but these standards have not been widely adopted. Problems relating semantic mapping among different metadata

items (or towards a commonly established ontology) also arise in other application fields, such as cultural heritage digital libraries [12] and niches search engines [13].

In the framework of a SOA application, each DMS can be regarded as completely autonomous, and no assumption can be made about its own capabilities. Instead, flexibility/extensibility in metadata management can be the crucial feature to enable DMS interoperability at this particular level. Such a feature is typical of an ebXML registry, which can thus be proficiently coupled to other similar legacy modules.

With no common set of metadata to be taken as reference, we can think of explicitly working with different metadata sets in a coordinated way. The coordination mechanism, according to the SOA approach, has to be implemented in the software layer that accesses the single services. Therefore, the service signature must be general enough to allow passing a list of name/value pairs to describe multiple metadata items: the service will then parse the list and behave accordingly to what pairs are actually meaningful on the specific DMS.

Implemented Modules

We built up a sample implementation of our architecture using popular software modules for the three components. As for the ebXML part, we took into consideration freebXML [14]. Moreover, our partner Pivot Consulting s.r.l. provided us with Hummingbird DM, a well-known commercial DMS: we managed to make it an interoperable DMS implementing the Web service wrapper we described as a standard interface. For the controller role we developed a demonstrative Web application, in order to allow user interaction (this should be changed in an automated scenario).

Related Works

SoDOCM [15] is an example of federated information system for document management, whose declared goal is to transparently manage multiple heterogeneous DMSs, while retaining their autonomy. It is based on the mediator architecture, a well-known concept developed for database interoperability, and follows the service-oriented computing paradigm.

LEBONED [16] is a metadata architecture that allows the integration of external knowledge sources into a Learning Management System. Access to digital libraries is provided through a Web service interface to import documents and metadata.

OAI compliance and metadata re-modeling are a central issue of the eBizSearch engine [13]. The authors managed to enable OAI access to the CiteSeer digital library: the proposed solution consists in periodically mirroring the original library and extending this external database to meet OAI specifications.

Conclusions and Future Works

Integrating different content management systems within a real-world, modern enterprise presents several interoperability issues, both on the access methods and the metadata models. Despite of the existence of a widely accepted standard, the ebXML specifications, most companies still operate upon legacy systems and pay little attention to interoperable infrastructures. In this paper, we presented an architectural solution for the integration of traditional DMSs with a standard ebXML Registry, allowing advanced metadata management over pre-existing legacy systems, while keeping the old information system up and running.

The proposed solution is focused on architectural issues, yet leaving out a few aspects located at the application level and regarding metadata consistency (namely, the initial integration and commit/rollback functionalities over subsequent write operations). Our future work will also involve a more thorough analysis of administration functions, which are excluded from the current version of the DMS interface, and of the controller module.

References

1. Electronic Business Using eXtensible Markup Language. http://www.ebxml.org/
2. Bechini, A., Cimino, M.G.C.A., and Tomasi, A. (2005). Using ebXML for Supply Chain Traceability – Pitfalls, Solutions and Experiences. *In Proceedings of 5th IFIP I3E Conference*, Springer, 497–511
3. Bechini, A., Cimino, M.G.C.A., and Marcelloni, F., et al. (2007). Patterns and technologies for enabling supply chain traceability through collaborative e-business. *Information & Software Technology*, Elsevier, 50(4): 342–359
4. OASIS (2005). ebXML Registry Information Model specification version 3.0. http://docs.oasis-open.org/regrep/regrep-rim/v3.0/regrep-rim-3.0-os.pdf
5. OASIS (2005). ebXML Registry Services specification version 3.0. http://docs.oasis-open.org/regrep/regrep-rs/v3.0/regrep-rs-3.0-os.pdf
6. Bechini, A., Tomasi, A., and Viotto, J. (2007). Document Management for Collaborative E-Business: Integration of the ebXML Environment with Legacy DMSs. *In Proceedings of International Conference on E-Business (ICE-B)*, 78–83
7. EMC Corporation (2003). Developing Web Services with Documentum. http://www.software.emc.com/collateral/content_management/documentum_family/wp_tech_web_svcs.pdf
8. FileNet Corporation (2007). IBM Filenet P8 Platform. http://www.filenet.com/English/Products/Datasheets/p8brochure.pdf
9. Vignette Corporation (2005). Vignette Portal and Vignette Builder. http://www.vignette.com/dafiles/docs/Downloads/WP0409_VRDCompliance.pdf
10. Dublin Core Metadata Initiative. http://dublincore.org
11. Open Archives Initiative. http://www.openarchives.org/
12. Bechini, A., Ceccarelli, G., and Tomasi, A. (2004). The Ecumene Experience to Data Integration in Cultural Heritage Web Information Systems. *In Proceedings of CAiSE Workshops*, vol. 1, 49–59
13. Petinot, Y., Teregowda, P.B., Han, H., et al. (2003). eBizSearch: an OAI-Compliant Digital Library for eBusiness. *In Proceedings of JCDL 2003*, IEEE CS Press, 199–209

14. FreebXML. http://www.freebxml.org/
15. Russo, L. and Chung, S. (2006). A Service Mediator Based Information System: Service-Oriented Federated Multiple Document Management. *10th IEEE International Enterprise Distributed Object Computing Conference Workshops (EDOCW'06)*, 9
16. Oldenettel, F., Malachinski, M., and Reil, D. (2003). Integrating Digital Libraries into Learning Environments: The LEBONED Approach. *In Proceedings of the 2003 IEEE Joint Conference on Digital Libraries*, IEEE Computer Society, Washington DC, USA, 280–290

"Field of Dreams" in Knowledge Management Systems: Principles for Enhancing Psychological Attachment Between Person and Knowledge

M. Comuzzi[1] **and S. L. Jarvenpaa**[2]

Abstract How can self-generating KMS be designed so that contributions arise from intrinsic motivation, or knowledge worker's personal attachment to knowledge, rather than external influences? Building on previous work on psychological attachment in information systems and psychological ownership in organizational sciences, we introduce KMS design principles that strive for harmony among knowledge workers, their knowledge, and others exploiting the knowledge in the organization. Our proposed design principles are aimed to increase knowledge workers' contributions to KMS by supporting employees' psychological attachment to knowledge.

Introduction

Knowledge management systems (KMS) are "IT-based systems developed to support and enhance the organizational processes of knowledge creation, storage/retrieval, transfer, and application" [1] within an organization.

The literature on Knowledge Management Systems (KMS) largely assumes that "an individual's knowledge can be captured and converted into group or organization-available knowledge" [2]. When individuals do not contribute to such systems, the knowledge creation capability of the firm is adversely affected [1]. However, there is little clarity in the information systems literature on what mechanisms are necessary for conversion to take place. Many in the information systems literature [3–5] have argued for social influences (such as culture), hierarchical authority, and/or economic incentives, all of which are external influences that rely on the broader social context outside the KMS system.

[1]Politecnico di Milano, Dipartimento di Elettronica e Informazione, Milan, Italy, comuzzi@elet.polimi.it
[2]University of Texas at Austin, McCombs School of Business – Center for Business Technology and Law, Austin, TX, USA, sirkka.jarvenpaa@mccombs.utexas.edu

An alternative view to these external influences is internal or intrinsic motivation. This view assumes that there is little that a broader context outside of the person and the person's interactions with KMS can do to enhance contributions. "Creating and sharing knowledge are intangible activities that can neither be supervised nor forced out of people. They only happen when people cooperate voluntarily" [6]. Intrinsic motivation implies that the activity is performed because of the immediate satisfaction it provides in terms of flow, self-defined goal, or obligations of personal and social identity rather than some external factor or goal. The external factors can even undermine knowledge contributions if they interfere with intrinsic motivation [7].

Although both views are likely to play a role in knowledge sharing, the internal view is important in organizations that take on characteristics of knowledge era (or postmodern) organizations. Such organizations require a more participative and self-managing knowledge worker compared to industrial era organizations [8]. In a postmodern organization, an employee's commitment to his or her organization results from autonomous forms of organizing and the resulting self-expression and feelings of responsibility and control of the outputs of work [9]. With knowledge workers, where work is associated with flows of knowledge and information, rather than flows of materials, self-expression, responsibility, and control are often targeted to knowledge outputs. Knowledge workers want to share their knowledge across the organization while preserving their association to these contributions.

In knowledge intensive organizations, people's distinctiveness depends upon their possessed knowledge. KMS that do not help construct, communicate, and defend the psychological attachment between the knowledge and the knowledge worker, and the rest of the organization can reduce the motivation to contribute knowledge to KMS. Fostering psychological attachment is likely to increase the knowledge workers quality of contributions, not only the quantity.

Theoretical Background

In the KMS literature, [8] and [10] have considered psychological attachment as a form of intrinsic motivation [11]. Psychological attachment comes from the fulfilment of affective processes that make system use personally meaningful.

In organizational sciences, psychological attachment to inanimate objects is captured in the notion of psychological ownership [12, 13]. Psychological ownership (PO) refers to a person's cognitive and affective state of mind wherein he or she associates a material or immaterial object to the self [11, 12] to satisfy his or her basic motivational needs for action. Psychological ownership is particularly important in terms of giving meaning of efficacy, self-identity, and security to people [13]. PO may refer to organizational objects that are either physical, such as office space, or immaterial, such as knowledge. Psychological ownership gives rise to two behavioural expressions of (1) identification and (2) control [12]. Personal control and identification with knowledge can increase the knowledge worker's effort level as

well as the knowledge worker's organizational commitment by creating associations that root the individual more firmly in the organization.

Feelings arising from PO lead to exhibition of behaviours related to constructing, communicating, and securing the personal attachment (e.g., association to knowledge) in the organization [12]. People can construct an organizational object as a symbolic expression of themselves (self-identity) and communicate that to others. People can also construct and communicate an organizational object in a way that regulates access to it. This act of regulation helps to secure the association particularly against perceived or actual infringement over one's ownership of the object.

Design Principles for KMS

The first design principle harnesses a knowledge worker's psychological ownership with the knowledge contributed to the system. Constructing psychological attachment between knowledge in KMS and contributors involves making contributors experience the routes to PO, getting increasingly familiar with the contribution and controlling contributions by having to ability to associate their identity with them. The second principle concerns the communication of this association to others in the firm. Communication of psychological attachment is defined as an interactive process by which knowledge workers explicitly signal their psychological attachment to contributions to others and, at the same time, these others signal back their recognition of the association between knowledge and contributors. Finally, the third principle concerns the monitoring of others' behaviour on the KMS to secure psychological attachment. Security of personal attachment to knowledge is the degree to which knowledge workers feel far from danger and fear while referring to colleagues and peers' usage of their knowledge contributions in the KMS. Fears of malicious and infringing behaviours may disrupt the feeling of secured attachment and may reduce contributions to KMS. Monitoring helps reduce fears of or anxiety over possible infringement.

Decentralization on the Content Layer

In order to build PO over knowledge contributions, KMS should be designed to make users experience the three routes of PO identified in [13], that is, investing the self into the target, getting to intimately know the target, and, eventually, controlling the target. The target, in this case, refers to the content contributed to the KMS. The content managed by a KMS is far more complex than raw and transactional data stored in a database, including documents, expertise, or informal exchange of comments on given topics. Hence, we define the decentralization of control over the content layer of a KMS as the extent to which knowledge workers are left free to decide the structure and content of the knowledge units and metadata that are stored

in the KMS. Decentralization of the content layer helps knowledge workers to build a strong association with the knowledge they contribute to the system. As workers (1) invest themselves in the target, (2) come to know it intimately, and (3) maintain control over it, they experience PO, which strengthens their association with their knowledge [13, 14].

Representing knowledge using codified artifacts is often a challenging activity. For instance, software programmers experience daily issues in commenting software code, trying to formalize their design choices in order to be understood and reused by other software developers. Knowledge workers are likely to invest great resources in contributing to the system with their expertise, in terms of time and effort, which increases their PO of knowledge. Leaving knowledge workers free to organize the detailed structure and content of their knowledge units is also likely to make them experience a greater familiarity with the knowledge. They must first clearly define the knowledge in their own minds before it can be contributed, for instance, in reply to a colleague's question posted on a forum or codified and stored in project reports, presentations, or any other kind of "knowledge unit".

To engender PO, knowledge workers need to identify themselves within the KMS and associate their identity to the contributions they make to the system. Control over knowledge in the KMS can be experienced only when knowledge is directly associated with the identity of the knowledge source. Even though one has spent lot of time and effort in compiling a project report, feeling ownership of it, the psychological attachment to the report can be lost if the KMS does not provide a means to attach authorship information on the document. Metadata play a fundamental role in building an association between knowledge workers and their contributions. Decentralizing control over metadata allows knowledge workers' discretion in providing their details to the system or in specifying the keywords or categories used to address their expertise or the documents they are contributing to the system. When the KMS allows users to self-define their personal profiles and to easily attach personal identification to the contributions, users are more likely to experience the third route to PO, i.e., controlling the target of ownership.

Coordination of the Communication Infrastructure

The second design principle addresses the communication infrastructure. Specifically, we focus on how the communication infrastructure can be designed to support knowledge workers' ability to communicate their personal attachment to contributions. Communication is an interactive process that requires not only signalling of personal attachment to others but also recognition by others of one's psychological attachment to knowledge. Communication infrastructure principle has implications for ties within a local community in KMS as well as coordinating across communities in KMS.

KMS designed to coordinate across local communities are likely to facilitate knowledge workers communication of psychological attachment, because they

increase the likelihood of knowledge workers being connected to communities of interest. Therefore, communication infrastructure of KMS which facilitates the coordination of local communities increases the knowledge workers psychological attachment to contributions.

Because of the interactive character of communication, KMS that foster psychological attachment to knowledge have also to signal back recognition to knowledge workers. Signaling back recognition over contributions increases psychological attachment because it helps people fulfilling their needs for expressing self-identity and having a place within the organization [13]. People find pleasure and comfort in experiencing the others' recognition. Therefore people tend to internalize the psychological attachment of knowledge and to view it as expression of self-identity within the organization. Others' recognition is also likely to create the sense of "having a place" in the organization. People experience that the knowledge they possess helps them finding their place in the organization as experts on specific topics. What helps to foster recognition of the association by others? We argue that also in this case the degree to which the KMS facilitates the coordination of local communities is the answer. Previous research has demonstrated the importance of relational capital as a positive antecedent of knowledge sharing on expertise finding systems and electronics networks of practice [15, 16]. One of the dimensions of relational capital is the perceived norm of reciprocity. Higher network centrality implies a higher degree of social reciprocity on the network. Social reciprocation creates a social obligation to respect the association between a worker and his or her knowledge in the minds of those who use knowledge. We view signaling back recognition as a form of reciprocity of others towards contributors. Then, when KMS are designed to increase users' network centrality, people are more likely to experience the feeling of reciprocity to others in the network. Reciprocity behaviours in knowledge work span from citing explicitly others' documents in project reports to signaling others' contributions using links to pages authored by others in wiki and intranets.

Decentralization of Monitoring Capabilities

Besides communication of the association within the firm, the KMS needs to provide knowledge workers with features to secure their association with knowledge from the watchful attention of others or, more specifically, infringement [12]. Infringing and malicious behaviours may occur when people want to increase their expertise status in the communities they value. In order to increase their expert status, knowledge workers may try to undermine the relationship between knowledge sources and contributions on the KMS. Let us consider the example of collaborative work on a wiki. Users may destroy (unlink) contributions made by others if these contributions are undermining their expert status within the community. In other contexts, such as discussion forums, users, in reply to a posted question, may show themselves as experts on specific topics by appropriating of others' contributes to the system. Only KMS that provide design features that reduce the likelihood of

these behaviours can encourage knowledge workers feel secure about the personal attachment to their contributions.

We argue that secure attachment to contributions can be guaranteed by decentralized monitoring capabilities of the KMS. Control over the KMS monitoring capabilities can be centralized or decentralized. In the centralized configuration, a central entity, such as the information systems function, defines and customizes KMS monitoring policies. The central entity responsible of monitoring has no interest in using monitoring to detect malicious behaviour of knowledge workers because it normally tends to use monitoring information to design external incentives for the usage of the KMS. Conversely, this interest is prominent in contributors to the KMS. Contributors want to be able to monitor others' interactions with their contributions to fulfill their need to secure their psychological attachment to contributions. KMS that facilitates knowledge workers in monitoring others' behaviors increase psychological attachment to contributions because they facilitate the expression of defending behaviours arising from PO.

Discussion and Implications

The paper proposed design principles to support knowledge workers in building psychological attachment to contributions, securing this psychological attachment and communicating this association to the communities of interest in the organization.

The research has implications for managers and IS designers. Concerning managers, the paper underlines the importance of designing KMS that builds on the intrinsic motivators of knowledge workers. We focused on psychological attachment to contribution as a specific form of intrinsic motivation. Concerning designers, we identified the high level functionalities that have a specific impact on fostering the psychological attachment of knowledge workers to contributions, that is, the structure of data and metadata, the communication infrastructure and the monitoring capabilities of the KMS.

References

1. Alavi, M. and Leidner, D.E. (2001). Knowledge Management and Knowledge Management Systems: Conceptual Foundations and Research Issues, *MIS Quarterly* (25)1, pp. 107–136
2. O'Leary, D.E. (1998). Knowledge Management Systems: Converting and Connecting, *IEEE Intelligent Systems* (13)3, pp. 34–39
3. Ba, S., Stallaert, J., and Whinston, A.B. (2001). Research Commentary: Introducing a Third Dimension in Information Systems Design–The Case for Incentive Alignment, *Information Systems Research* (12)3, pp. 225–239
4. Jarvenpaa, S.L. and Staples, D.S. (2000). The Use of Collaborative Electronic Media for Information Sharing: An Exploratory Study of Determinants, *Journal of Strategic Information Systems* (9)2–3, pp. 129–154

5. Malhotra, Y. and Galletta, D.F. (2003). Role of Commitment and Motivation in Knowledge Management Systems Implementation: Theory, Conceptualization and Measurement of Antecedents of Success, in Proceedings of the 36th Hawaii International Conference on System Sciences, Hawaii
6. Kim, W.C. and Mauborgne, R. (1988). Procedural Justice, Strategic Decision Making, and the Knowledge Economy, *Strategic Management Journal* (19)4, pp. 323–338
7. Osterloh, M. and Frey, B.S. (2000). Motivation, Knowledge Transfer, and Organizational Forms, *Organization Science* (11)5, pp. 538–550
8. Rousseau, D.M. and Rivera, A. (2003). Democracy, a Way of Organizing in a Knowledge Economy, *Journal of Management Inquiry* (12)2, pp. 115–134
9. Van Dyne, L. and Pierce, J.L. (2004). Psychological Ownership and Feelings of Possession: Three Field Studies Predicting Employee Attitudes and Organizational Citizenship Behaviour, *Journal of Organizational Behavior* 25, pp. 439–459
10. Markus, M.L. (2001). Toward a Theory of Knowledge Reuse: Types of Knowledge Reuse Situations and Factors in Reuse Success, *Journal of Management Information Systems* 18(1), pp. 57–93
11. Malhotra, Y. and Galletta, D. (2005). A Multidimensional Commitment Model of Volitional Systems Adoption and Usage Behavior, *Journal of Management Information Systems* 22(1), pp. 117–151
12. Brown, G., Lawrence, T.B., and Robinson, S.L. (2005). Territoriality in Organizations. *Academy of Management Review* 30(3), pp. 577–594
13. Pierce, J.L., Kostova, T., and Dirks, K.T. (2001). Toward a Theory of Psychological Ownership in Organizations, *Academy of Management Review* 26(2), pp. 298–310
14. Pierce, J.L., Kostova, T., and Dirks, K.T. (2003). The State of Psychological Ownership: Integrating and Extending a Century of Research, *Review of General Psychology* 7(1), pp. 84–107
15. Tiwana, A. and Bush, A.A. (2005). Continuance in Expertise-sharing Networks: A Social Perspective, *IEEE Transactions on Engineering Management* 52(1), pp. 85–101
16. Wasko, M.M. and Faraj, S. (2005). Why Should I Share? Examining Social Capital and Knowledge Contribution in Electronics Networks of Practice, *MIS Quarterly* 29(1), pp. 35–57

Knowledge Acquisition by Geographically Isolated Technical Workers: The Emergence of Spontaneous Practices from Organizational and Community-Based Relations

V. Corvello and P. Migliarese

Abstract The expression *geographically isolated technical workers* (GITWs) addresses those individuals which carry out technical tasks *and* work distant from *any* other member of their organization. In recent years firms have made substantial investments in Knowledge Management Systems (KMSs) in order to support knowledge acquisition by distant workers. KMSs, however, did not meet the expected target. KM-related activities are perceived by GITWs as tiresome and extraneous to their task. In order to improve its effectiveness, KM needs to be integrated in the daily practices of workers. Through the study of two cases, this paper analyzes the practices spontaneously enacted by GITW to acquire technical knowledge. It builds on the theory of Communities of Practice by considering how formal organizational relations, as well as community-based ones, contribute to the emergence of spontaneous practices. The obtained results are used to formulate recommendations on KMSs design and management.

Introduction

The expression geographically isolated workers is used to address those individuals which carry out their job distant from any other member of their organization. This situation is common within sales departments, among installation and maintenance workers, in the logistics and transport sectors, within engineering and consultancy firms [1]. Telework and e-work, besides, allow people to carry out remotely jobs which once required to stay at the organization's site.

Many isolated workers carry out jobs requiring strong technical competences and frequent retraining. In this case we call them geographically isolated *technical* workers (GITWs). Organizations need to make their GITWs able to access the knowledge they need to perform their job. The difficulties in exchanging knowledge

Università della Calabria, Dipartimento di Scienze Aziendali, Arcavacata di Rende, Cosenza, Italy, corvello@unical.it, piero.migliarese@unical.it

from a distance have been repeatedly highlighted in the literature [2–5]. In recent years, firms have made substantial investments in Knowledge Management (KM) in order to overcome these difficulties. Knowledge Management Systems (KMSs), however, did not meet the expected target [6, 7]. In a recent survey regarding the most used tools by knowledge workers, KMSs did not even appear [8]. Knowledge workers prefer tools as email or instant messaging. A reasonable hypothesis to explain this phenomenon, is that KMSs require an individual to carry out activities he considers extraneous to his task: "knowledge workers are paid to be productive, not to fill in forms or to browse the internet" [9]. To be effective, KM processes need to be integrated in the daily practices of workers.

Through the analysis of two in depth case studies, this paper aims to improve our comprehension of the practices spontaneously enacted by GITWs to acquire technical knowledge. The obtained results are used to formulate recommendations about the organizational and technological features required to KMSs to effectively support GITWs. The underlying hypothesis is that designing KMSs in order to support these practices, can be a more effective approach than redesigning the same working practices in order to meet KM needs.

Conceptual Background

This paper focuses on the practices spontaneously enacted by GITWs in order to acquire technical knowledge. Technical knowledge is *know how* [10] related to the transformation of artefacts.

GITWs, as any other technical worker, develop *spontaneous practices* for the acquisition of technical knowledge, as a part of their main working practices. According to Lave and Wenger [11] practices are always developed through repeated interactions within so called Communities of Practice (CoPs). CoPs are groups of individuals, linked by often informal relations, which share a joint enterprise, mutual engagement and a shared repertoire [12]. Even if the literature emphasizes the role of informal, community-based relations in shaping working practices, they are shaped as well by the formal relations created by the organizational structure.

Analyzing the role that both formal and informal relations have in shaping the emergent practices for knowledge acquisition is one of the aims of this study.

Knowledge acquisition is understood here in a broad sense: all the modes available to an individual to fill the gap between what he knows and what he needs to know to accomplish his task. Within an organization, there are *two modes* for an individual to acquire the knowledge he needs: learning and knowledge substitution. *Learning* is the process which leads an individual to interiorize knowledge. The expression *knowledge substitution* [13] addresses all those cases in which an individual acts on the basis of someone else's knowledge (e.g. following a superior's instructions or applying an organizational procedure).

There are several reasons to hypothesize that GITWs' practices for knowledge acquisition are different from those enacted by their co-located colleagues:

1. The scarce richness of the used media limits communication effectiveness.
2. Distance inhibits *interpersonal networking* and, as a consequence, the possibility to learn from peers or to build networks for knowledge exchange.
3. Asymmetries in *knowledge content* (i.e. what each worker knows) and in the c*ognitive background* (i.e. the mental schemes the different workers use to interpret each piece of knowledge) are likely to emerge as a consequence of the barriers to knowledge diffusion imposed by physical distance.

Which features, then, distinguish the spontaneous practices for knowledge acquisition enacted by GITWs from those enacted by workers in different situations?

The case studies discussed in the following sections try to answer this question.

Research Method and Setting

The empirical research has an explorative nature. Two case studies have been carried out in organizations employing GITWs. The first has been considered a pilot study. Insights from this case have been further investigated in the second one.

The first organization, called *Alfa* in this paper, is a prestigious research centre located in central Italy. Its main activity is the design and development of information systems in support of humanistic research. Its customers are the Italian Ministry of Research, public archives, universities and other research institutions. Among the carried out projects there are specialized search engines, virtual libraries, tools for the management of archival collections. The Centre has about thirty people at the headquarter and about fifty geographically distributed collaborators. The people at the headquarter are divided in researchers and technicians. Researchers define the requirements and scientific criteria for each project, while technicians are in charge of the technical design and implementation of the new systems. The collaborators' task is to edit the electronic versions of rare books or ancient drawings. They need strong humanistic and technical competences. Alfa takes a dispersed work approach: the collaborators work from distant locations (e.g. universities or their homes), and are supported by the central staff.

The second organization, called *Beta* in this paper, is a large Italy-based company. It supplies turbomachinery, compressors, pumps, valves, metering and fuel distribution equipment and services. The firm has 3,500 employees and it has a turnover of about 2,000 million dollars.

This study focuses on the so called technical advisors (TAs), that is, employees which are in charge of installation, start up and maintenance of the products. They work at the customers' sites, often in difficult conditions (e.g. on oil rigs). Strong technical competences are critical for TAs because of the variety of systems Beta's products are to be integrated in, and because of the time pressure TAs are subjected to. Most of the times TAs work alone or in couples. They are specialized by product. Since there are three main categories of products, there are also three main specializations for TAs: turbines, compressors and control systems. TAs report to a project manager. They are constantly in touch with the so called PM2 (Project Manager 2),

Table 1 Sources of data in the two case studies

	Alfa	Beta
Questionnaire	13 returned	16 returned
Interviews	18 (at least 45 min each)	20 (at least 45 min each)
Key informant	Present	Present
Direct observation	Three visits, 1 week each	Two visits, 1 week each
Documents	Manuals; Email; Semi-finished texts	Manuals; Email

a liaison role which supports the TAs from the headquarter giving them advice, linking them to the organization, preparing documents with instructions for their work. Two years ago an office was created at the headquarter made up with expert TAs, which give technical advice to their distant colleagues.

In both cases the research went through three phases. A key informant was present at each of the two organizations. In the first phase the key informants were interviewed several times in an unstructured way. In the second phase data were collected regarding the actions taken by GITWs in order to acquire knowledge when a technical problem arises. Several sources (see Table 1) have been used in order to improve validity [14]. The data collected regarded the following factors:

1. The nature and content of the exchanged knowledge
2. The people or artifacts involved in the process
3. The outcome of the search process (instructions, opinions, discussions)
4. The used tools
5. The background of the involved people (education, experience, seniority)

Data were analyzed using various qualitative techniques as template analysis [14] and pattern matching [15].

In the third phase more conversations with the key informants and with other members of the two organizations were held in order to validate the results.

Results

The collected and analyzed data point out two factors:

1. The relevance of the liaison roles in the knowledge acquisition process
2. The different approaches to knowledge acquisition adopted by GITWs when they are distant and when they are at the organization's site

In Alfa each remote collaborator is assigned to a "tutor", while in Beta, the liaison between the TA and the organization is the PM2.

In Alfa, most of the problems from the point of view of knowledge acquisition, are related to new projects. When a new project starts, scientific criteria and technological tools are chosen by the central staff. The distributed collaborators are made aware of the new guidelines and resources (e.g. new software or manuals) through

a website and through informal communications. This is obviously not sufficient to transfer the necessary knowledge. When GITWs are not able to solve a problem, they ask a trusted colleague or, more often, the tutor for help. The tutor gives suggestions; corrects, proofread, and completes GITWs' work; puts them in touch with specialists within the organization.

In Beta, TAs have access to an intranet through which they can communicate with distant colleagues, receive information, ask for support. E-learning activities can also be carried out through the intranet. The provided communication and KM tools however, are not much used. TAs turn often to colleagues when they meet with difficulties. The preferred medium is the telephone (or VoIP, when available), followed by email. When a problem arises that is related to the TA's specific knowledge domain (e.g. malfunctioning of a turbine for a turbine specialist) the first attempt is usually directed to a trusted colleague. When the problem is related to heterogeneous knowledge domains (e.g. a turbine specialist has a problem with the system the turbine has to be integrated in) the TA usually asks his PM2. If the PM2 has not a solution, he asks a specialist. Through these communication chains, both know how and know who are diffused through the organization.

A second relevant observation is that learning from colleagues happens, for the most part, during the periods the GITWs spend at the headquarter. When the GITW is distant he mainly looks for precise instruction or rules of behaviour.

In Alfa, when the GITWs are at the headquarter for a refresher course, they spend most of their time discussing with colleagues about the problems met and about the novelties related to the project they work in. When distant, instead, they mainly communicate through detailed emails which describe the problems met.

Also within Beta the period between two missions is spent in discussions with colleagues about work-related problems. Recently an interesting practice has spontaneously developed: during a mission the PM2 takes note of all the problems met by the TA and of the persons who contributed to solve them. When the TA comes back he meets with the people on the list to discuss the problem.

Discussion

The conducted analysis made three relevant observations emerge:

1. In their daily practices GITWs make use of different modes for knowledge acquisition (i.e. learning or knowledge substitution) in different situations. In particular, when GITWs are distant they tend to search for instructions and well defined rules of behavior (i.e. they use knowledge substitution). The comprehension and interiorization of the underlying knowledge (i.e. learning) is postponed to the periods spent at the headquarter.
2. GITWs tend to exploit their personal relationships to retrieve knowledge related to their specialist knowledge domain. They involve formal organizational roles when looking for knowledge belonging to a different domain.

3. Some individuals, because of their formal role within the organizational structure (e.g. tutors in Alfa or PM2 in Beta) are involved in many chains of communications activated by GITWs to retrieve knowledge. As a consequence they gain both know who and know how in several domains of expertise.

Knowledge acquisition, then, is a cyclical process: GITWs can develop technical knowledge through personal experience, but it is during the periods spent at the organization's site that they share it with their colleagues and improve their understanding of a subject. While they are distant, knowledge substitution provides an efficient mode to rapidly obtain the knowledge needed to perform a task.

The liaison roles are introduced for operative reasons, not for KM-related needs Neither they participate, if not marginally, in the GITWs' CoPs. Nonetheless, GITWs spontaneously involve them in their searches for knowledge. While performing their job, in fact, GITWs have not the time or the resources to retrieve the needed knowledge themselves. Only when they are confident to rapidly find a solution, they ask someone they know. Otherwise they "outsource" the search process to someone else. The liaison roles have easy access to people and resources at the headquarter, are often linked to the GITWs by personal relationships, know the work to be carried out, communicate with the GITWs frequently and share with them communication routines. For all these reasons they are the most appropriate persons to support the GITWs also from a KM perspective.

Conclusions

The aim of this study has been to single out regularities in the practices for knowledge acquisition spontaneously enacted by GITWs as a part of their overall working practice. The obtained results and the observations made in the previous section have implications for both KMSs research and practice.

The contribution to research consists mainly in two observations:

1. Knowledge acquisition is characterized by different modes when GITWs are at the organization's site and when they are distant. Research on KM could benefit from longitudinal studies highlighting how knowledge acquisition is the result of a cyclical process and how different tools are needed at different times.
2. Working practices are shaped by the formal organizational structure as much as by community-based relationships. The role of the organizational structure is much under-investigated in the existing literature on emergent practices.

This study has also implications for KMSs design and management. KMSs are designed assuming that the same worker who searches for knowledge will apply it. This would be the ideal situation, but several factors make it difficult for GITWs to use KMSs directly: transfer of complex knowledge is limited by media poorness, access to a connection or even to a computer might be difficult, work is performed under time pressure. For these reasons KM-related activities are delegated to liaison roles. KM tools, then, need to be designed thinking that they will be used also by a

non specialist with a brokering role. Structuration of data, interfaces and procedures design need to fit both GITWs' and liaison roles' needs.

The liaison people is usually there for operative reasons. They have not explicit KM responsibilities. Introducing these responsibilities and giving the related training could significantly improve KMSs performance in the case of GITWs.

In the end, e-learning tools were neglected by the interviewed GITWs. Learning takes place mainly during the periods spent at the headquarter. E-learning seems more useful as asynchronous learning, rather than as distance learning. E-learning tools and KMSs can support knowledge capture and diffusion during the periods spent at the organization's site by GITWs.

References

1. Corso, M., Martini, A., Pellegrini, P., Massa, S., and Testa, S. (2006) Managing Dispersed Workers: The New Challenge in Knowledge Management. *Technovation*, 26, 583–594
2. Corvello, V. and Migliarese, P. (2007) Virtual Forms for the Organization of Production: A Comparative Analysis. *International Journal of Production Economics*, 110(1–2), 5–15
3. Cramton, C. (2001) The Mutual Knowledge Problem and its Consequences for Dispersed Collaboration. *Organization Science*, 15(3), 346–371
4. Orlikowski, W. (2002) Knowing in Practice: Enacting a Collective Capability in Distributed Organizing. *Organization Science*, 16(3), 249–273
5. Raghuram, S. (1996) Knowledge Creation in the Telework Context. *International Journal of Technology Management*, 8, 859–870
6. Kazi, A. S. and Wolf, P. (2006) Real Life Knowledge Management: Lessons from the Field. http://www.knowledgeboard.com/lib/3236
7. King, N. (1995) The qualitative research interview. In: Cassell, C. and Symon, G. (eds.), *Qualitative Methods in Organisational Research*. London: Sage
8. Davenport, T. H. (2005) *Thinking for a Living: How to get Better Performance and Results from Knowledge Workers*. Boston: Harvard Business School Press
9. McAfee, A. P. (2006) Enterprise 2.0: The Dawn of Emergent Collaboration. *MIT Sloan Management Review*, 3, 21–28
10. OECD (2000) *Knowledge Management in the Learning Society*. Paris: OECD
11. Lave, J. and Wenger, E. (1991) *Situated Learning: Legitimate Peripheral Participation*. Cambridge: Cambridge University Press
12. Migliarese, P. and Verteramo, S. (2005) Knowledge creation and sharing in a project team: An Organizational Analysis Based on the Concept of Organizational Relation. *The Electronic Journal of Knowledge Management*, 2, 97–106
13. Conner, K. and Prahalad, C. K. (1996) A Resource-Based Theory of the Firm: Knowledge Versus Opportunism. *Organization Science*, 10(7), 477–501
14. Wenger, E. (1998) *Communities of Practice, Learning, Meaning and Identity*. Cambridge: Cambridge University Press
15. Yin, R. (1994) *Case Study Research 2nd Ed.*, Thousand Oaks, CA: Sage

Where Does Text Mining Meet Knowledge Management? A Case Study

E. D'Avanzo[1], A. Elia[1], T. Kuflik[2], A. Lieto[1], and R. Preziosi[1]

Abstract Knowledge management in organizations is about ensuring that the right information is delivered to the right person on the right time. How can the right information be easily identified? This work demonstrates how text mining provides a tool for generating human understandable textual summaries that ease the task of finding the relevant information within organizational documents repositories.

Introduction

Knowledge management (KM) is aimed at serving business practices, being originated in the business world as a method for unifying the vast amounts of information generated from meetings, proposals, presentations, analytic papers, training materials, etc. [1]. KM is primarily utilized by large organizations, although the problem of navigating a multiformat document corpus is relevant to any individual or group that creates and consumes distributed knowledge [2]. The documents created in an organization represents its potential knowledge. "Potential" because only parts of this data and information will be found "helpful" to be used by them to create organizational knowledge. To be defined "helpful" it is necessary that information that can be rephrased as Polany's notion of explicit knowledge will be relevant for the business of that organization [3]. In this view, one major challenge is the selection of relevant information from vast amounts of documents, and the ability of making it available for use and re-use by organization members. The objective of the "mainstream" of the knowledge management is to ensure that the right information is delivered to the right person at the right time, in order to take the most appropriate decision. In this sense, KM is not aimed at managing knowledge per se, but to

[1]Università di Salerno, Fisciano, Salerno, Italy, edavanzo@unisa.it, aelia@unisa.it, alieto@unisa.it, rpreziosi@unisa.it
[2]The University of Haifa, Haifa, Israel, tsvikak@mis.hevra.ac.it

relate knowledge and its usage. Along this line we focus on the extraction of relevant information to be delivered to a decision maker.

To this end, a range of Text Mining (TM) and Natural Language Processing (NLP) techniques can be used as an effective Knowledge Management System (KMS) supporting the extraction of relevant information from large amounts of unstructured textual data and, thus, the creation of knowledge [1], as demonstrated by this work. The rest of the paper is structured as follows: Section "Related Work" surveys some related work. Section "Case Study: A Lingustic Approach To Knowledge Management" describes our approach to KM. Section "LAKE Evaluation" reports on an experiment performed in the Document Understanding Conference (DUC). Finally, section LAKE Evaluation, discusses the methodology and the its evaluation and section "Discussion and Conclusion" concludes the paper.

Related Work

Rajman et al. [4] show two examples of TM tasks that are useful for knowledge management, especially because they support the extraction of information from collections of textual data. Both tasks involve an automated synthesis of documents content. One system exploits an association extraction method operating on indexed documents. This provides the basis for extracting significant keywords associations. Then an incremental algorithm allows exploring the possible sets of keywords, starting from the frequent singletons and iteratively adding keywords that produce new frequent sets. The other example of [4] applies knowledge discovery techniques to the complete textual content of documents, using a prototypical document extraction algorithm. This approach has shown that the results are better if the extraction process operates on abstract concepts represented by the keywords rather than on the actual words contained in the documents. The authors support the need of applying Natural Language techniques to identify more significant terms.

Feldman et al. [5] describe Document Explorer, a tool that implements text mining at the term level in different steps. Document retrieval module converts retrieved documents from their native formats into SGML. These resulting documents are then processed to provide additional linguistic information about their content. Then, documents are labelled with terms extracted directly from them by a syntactic analysis. The terms are placed in a taxonomy through interaction with the user, as well as via information provided when documents are initially converted into Document Explorer's SGML format. Finally, Knowledge Discovery in Databases (KDD) operations are performed on the term-labelled documents.

The authors claim that the results confirm that TM can serve as a powerful technique to manage knowledge encapsulated in large document collections.

NLP has developed techniques that might be beneficial for KM. [6], for example, discuss two approaches, the first extracts general knowledge directly from text, by identifying in natural language documents references to particular kinds of objects such as names of people, companies and locations. The second extracts structured

data from text documents or web pages and then apply traditional Knowledge Discovery methods (inductive or statistical methods for building decision trees, rule bases, non-linear regression for classification, ...) to discover patterns in the extracted data. This approach requires pre-processing of the corpus of documents into a structured database that is used for discovering interesting relationships by different methods like prediction rules. Litowski [7] and Computational Linguistics Research Group at the University of Essex (CL Research) demonstrates an approach that has developed an interface for examining question-answering performance that evolved into a KMS that provides a single platform for examining English documents (e.g., newswire and research papers) and for generating different types of output (e.g., answers to questions, summaries, and document ontologies), also in XML representation. For these tasks, CL Research uses Proximity Parser that consists of bracketed parse trees, with leaf nodes describing the part of speech and lexical entry for each sentence word. After each sentence is parsed, its parse tree is traversed in a depth-first recursive function. During this traversal, each nonterminal and terminal node is analysed to identify discourse segments (sentences and clauses), noun phrases, verbs, adjectives, and prepositional phrases. As these items are identified, they are subjected to additional analysis, characterizing them syntactically and semantically. This includes word-sense disambiguation of nouns and verbs, and adjectives and semantic analysis of prepositions to establish their semantic roles. When all sentences of a document have been parsed and components identified and analysed, the various lists of items are used to generate XML representation of that document. This representation becomes the basis for question answering, summarization, information extraction, and document exploration based on the analysis of noun phrases to construct an ontology: functionalities of KMS that allow a user to explore documents in a variety of ways to identify salient portions of texts.

Dey et al. [8] focus on ontologies as tools for KM proposing a rough-set based method for grouping a set of documents into a concept hierarchy. Using a tolerance rough set based model, the documents are initially enriched by including additional terms that belong to the document's tolerance space, [9] defines a tolerance space as the tuple $TS = (U, \tau, p)$, which consists of a non-empty set U, called the domain of TS; a tolerance function τ; a tolerance parameter $p \in (0, 1)$. For a pre-classified collection of documents, the enrichment process is applied over each category. Concepts are extracted for each category. For heterogeneous collections, the enriched documents are first clustered using a two-phase iterative clustering algorithm. Finally the clusters are arranged to form a concept hierarchy, where each node in the hierarchy is represented by a set of concepts that covers a collection of documents. Each node is approximated by two sets of concepts. The lower approximation of a collection of documents represents a set of concepts that the documents definitely cover. The upper approximation of the collection represents a set of concepts that are possibly covered by the collection. The proposed mechanism has been tested for various domains and found to generate interesting concept hierarchies. It is presently being used to generate concept hierarchies over medical abstract collections. The concept approximations can be then used to index a collection effectively

to answer concept based queries. The proposed mechanism is also ideally suited to generate new domain ontologies.

Inniss et al. [10] describe the use of NLP techniques in a biomedical knowledge domain. The goal of their research is to initially determine a common vocabulary that can be used to describe Age-related Macular Degeneration (AMD) via the use of retinal experts. Retinal experts, who were in different geographic locations, describe their observations of the features informally using digital voice recorders. Their verbal descriptions are then transcribed into text. Another retinal clinician then, manually, parses the text and extracts all keywords which are then organized, using the clinician's domain knowledge, into a structured vocabulary for AMD, with candidate feature names, attribute names for those features and the possible values for those attributes. These feature attributes and values are then incorporated into the user interface of collaborative biomedical ontology development tool, Intelligent Distributed Ontology Consensus System (IDOCS). Experiments have been conducted on the same feature description text generated by the original interviews of the clinicians (eye experts) using a number of collocation discovery methods from NLP. If the goal of the project is to develop a biomedical ontology it needs to discover those concepts that occur most often in the most number of documents. For this purpose they used, on the transcribed interviews from the retinal experts, SAS' Text Miner to discover those terms or concepts that most frequently occur in the corpus of interviews. Finally they proposed a methodology to generate ontology in a semi-automated manner using human experts, and applying NLP solutions.

All these applications show how to develop KMS in which text mining is an effective tool that supports the extraction of relevant information from large amounts of unstructured textual data and the creation of knowledge. Moreover, most of them show that NLP techniques are beneficial for KM and KMS design.

Case Study: A Lingustic Approach to Knowledge Management

We propose an approach to KM based on the extraction of linguistically motivated keyphrases from documents. From an operative perspective, keyphrases represent a useful way to succinctly summarize and characterize documents, providing semantic metadata as well. More formally, a phrase is a "textual unit usually larger than a word but smaller than a full sentence" [11]. The term "syntactic phrase", denotes any phrase that is so according to the grammar of the language under consideration. A "statistical phrase is any sequence of words that occurs contiguously in a text" [11]. The keyphrases considered in our work belongs to one of these two kinds of phrases.

Keyphrases do not only work as brief summaries of a document's contents as Turney [12, 13] pointed out, but they can be used in information retrieval systems "as descriptions of the document returned by a query, as the basis for search indexes, as a way of browsing a collection, and as a document clustering technique" [14]. Our methodology, based on Keyphrase Extraction (KE, a method for automatic

identification of keyphrases in text), makes use of a learning algorithm to select linguistically motivated keyphrases from a list of candidates, which are then merged to form a document summary. The underlying hypothesis is that linguistic information is beneficial for the task, an assumption completely new with respect to the KE task state of the art research.

KE can be performed as a supervised machine learning task. In such case, a classifier is trained by using documents annotated with known keyphrases. The trained classifier is subsequently applied to documents for which no keyphrases are assigned: each defined term from these documents is classified either as a keyphrase or as a non-keyphrase. Both training and extraction processes choose a set of candidate keyphrases (i.e. potential terms) from their input document, and then calculate the values of the features for each candidate.

A prototype system, called LAKE (Linguistic Analysis based Knowledge Extractor), was developed, implementing the above-mentioned process [15, 16]. The system works as follows: first, a set of linguistically motivated candidate phrases is identified. Then, a learning device chooses the best phrases. Finally, keyphrases at the top of the ranking are merged to form a summary. The candidate phrases generated by LAKE are sequences of Part of Speech containing Multiword expressions and Named Entities. We define such elements as "patterns" and store them in a patterns database; once there, the main work is done by the learner device. The linguistic database makes LAKE unique in its category. The prototype consists of three main components: Linguistic Pre-Processor, Candidate Phrase Extractor and Candidate Phrase Scorer. The system accepts a document as an input. The document is processed first by Linguistic Pre-Processor which tags the whole document, identifying Named Entities and Multiwords as well. Then candidate phrases are identified based on the pattern database Up to now the process is the same for training and extraction stages. In training stage, however, the system is furnished with annotated document.[1] Candidate Phrase Scorer module is equipped with a procedure which looks, for each author supplied keyphrase, for a candidate phrase that could be matched, identifying positive and negative examples. The model that come out from this step is, then, used in the extraction stage. LAKE has been extended for Multidocument summarization purposes. Again it has been exploited the KE ability of the system, adding, however, a sentence extraction module able to extract a textual summary of pre-defined length from a cluster of documents. The module once extracted keyphrases for each document uses a score mechanism to select the most representative keyphrases for the whole cluster. Once identified this list, the module selects the sentences which contains these keyphrases.

Keyphrases obtained using the proposed method can be considered syntactic phrases, as pointed out by Caropreso et al. [11]. They, in fact, are obtained according to a small grammar defined in the pattern database. A key role has been played by the learning component of LAKE. The system in fact can exploit the generalization ability of the learning device and can be trained making use of a small number of annotated documents.

[1] For which keyphrases are supplied by the author of the document.

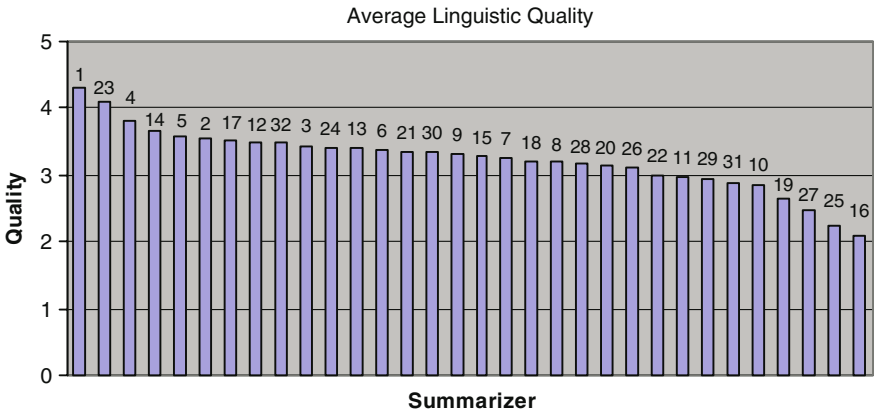


Fig. 1 Average linguistic quality

LAKE Evaluation

Document Understanding Conferences (DUC) is a series of text summarization conferences, presenting text summarization competitions results[2]. LAKE participated at DUC since 2004 while obtaining encouraging results every time. In this work, for brevity, we only report the linguistic quality of LAKE's summaries

Linguistic quality assesses how readable and fluent the summaries are, without comparing them with a model summary. Five Quality Questions were used, and all questions were assessed on a five-point scale from"1" (very poor) to "5" (very good). Being a linguistically motivated summarizer, LAKE is expected to perform well at the manual evaluation with respect to language quality and responsiveness. Regarding language quality, as can be expected, LAKE scored relatively high – it was ranked 6th out of the 30 systems for average language quality (see Fig. 1), with an average value of 3.502 compared to 3.41 – the overall average – and 4.23 which was the highest score of the baseline system (no 1) and very close to the second baseline system (no 2) that scored 3.56. However, we should note that most of the systems scored between 3.0 and 4.0 for linguistic quality, so the differences were relatively small. Compared to 2006, Lake got a little lower score (3.5 compared to 3.7), and was ranked relatively lower (3rd in 2006).

Discussion and Conclusion

NLP can be used as a tool to aid the extraction of relevant information from documents and, thus, for the creation of knowledge, especially when multiple relevant and different documents are integrated into a small coherent summary. The potential

[2] http://duc.nist.gov

benefits that can be obtained from integrating KM with text mining technology seem valuable. This work demonstrates the potential of linguistically motivated text mining techniques to support knowledge extraction for knowledge management while generating human readable summaries of sets of documents.

References

1. Bordoni, L. and D'Avanzo, E. (2002). *Prospects for Integrating Text Mining and Knowledge Management*. The IPTS Report (Institute for Prospective Technological Studies), Vol. 68
2. Nonaka, I. (1991). The knowledge creating company. *Harvard Business Review*, 69:96–104
3. Day, R.E. (2005). *Clearing Up "Implicit Knowledge": Implications for Knowledge Management, Information Science, Psychology and Social Epistemology*, Wiley-Interscience, New York
4. Rajman, M. and Besançon, R. (1997). *Text Mining: Natural Language Techniques and Text Mining Applications*, Proceedings of the 7th IFIP 2.6 Working Conference on Database Semantics (DS-7)
5. Feldman, R., Fresko, M., Hirsh, H., Aumann, Y., Lipshat, O., Schler, Y., and Rajman, M. (1998). *Knowledge Management: A Text Mining Approach*, Proceedings of the 2nd International Conference on Practical Aspects of Knowledge Management, 29–30
6. Mooney, R. J. and Bunescu, R. (2005). *Mining Knowledge from Text Using Information Extraction*, SIGKDD Explorations (special issue on Text Mining and Natural Language Processing), 7(1), 3–10
7. Litowsky, K. C. (2005). *CL Research's Knowledge Management System*, Prooceedings of the ACL Interactive Poster and Demonstration Session, 13–16
8. Dey, L., Rastogi, A. C., and Kumar, S. (2006). *Generating Concept Ontologies Through Text Mining*, Proceedings of the 2006 IEEE/WIC/ACM International Conference on Web Intelligence
9. Doherty P., Lukaszewics, W., and Szalas, A. (2003). *Tolerance Spaces and Approximative Representational Structure*, Proceedings of the 26th German Conference on Artificial Intelligence, volume 281 of LNAI
10. Inniss, T. R., Lee, J. R., Light, M., Grassi, M. A., Thomas, G., and Williams, A. B. (2006). *Towards Applying Text Mining and Natural Language Processing for Biomedical Ontology Acquisition*, Proceedings of the 1st International Workshop on Text Mining in Bioinformatics, 7–14
11. Caropreso, M. F., Matwin, S., and Sebastiani, F. (2001). *A learner-independent evaluation of the usefulness of statistical phrases for automated text categorization*. In Amita G. Chin (Ed.), *Text Databases and Document Management: Theory and Practice* (pp. 78–102) Hershey (US) Idea Group Publishing
12. Turney, P. D. (1999). *Learning to extract keyphrases from text*. Technical Report ERB-1057. (NRC #41622), National Research Council, Institute for Information Technology
13. Turney, P. D. (2000). Learning algorithms for keyphrase extraction. *Information Retrieval*, 2(4):303–336
14. Turney, P. D. (1997). *Extraction of keyphrases from text: Evaluation of four algorithms*. Technical Report ERB-1051. (NRC #41550), National Research Council, Institute for Information Technology
15. D'Avanzo, E. and Magnini, B. (2005). *A Keyphrase-Based Approach to Summarization: the LAKE System at DUC-2005*. DUC Workshop, Proceedings of Human Language Technology Conference/Conference on Empirical Methods in Natural Language Processing (HLT/EMNLP 2005)
16. D'Avanzo, E., Lavelli, A., Magnini, B., and Zanoli, R. (2003). *Using Keyphrases as Features for Text Categorization*. ITC-irst, Technical report, 12 pp. (Ref. No.: T03-11-01)

Ad-Hoc Maintenance Program Composition: An Ontological Approach

A. De Nicola, M. Missikoff, and L. Tininini

Abstract In this paper we introduce BPAL, an ontological framework able to support the formal modeling of business processes (BP). BPAL has been conceived to address the problem of dynamic process composition in the context of advanced logistics applications, more precisely Autonomic Logistics Services (ALS). The motivation is that in ALS we need flexibility in deciding when to start a maintenance process and how to structure it. We believe that an ontological approach fostering flexibility and dynamicity in BP will support the development of SALSA (Semantic Autonomic Logistic Services and Applications) system, which is our ultimate goal.

Introduction

The maintenance of large engineering artifacts (e.g. a radar system or a helicopter) is a very critical factor for the overall success of a large project. While scheduled maintenance interventions are relatively easy to be structured and planned, extraordinary interventions often take place in critical situations and require an ad-hoc planning of operations. Ad-hoc operations are costly and hence there is an increasing need to reduce unplanned interventions. An economically-efficient maintenance plan is gaining importance also because many enterprises are pushed to offer, in a large bid, a *Contractor Logistics Support*, i.e., a form of warranty that covers the entire life cycle of the sold product with quality parameters directly specified in the support contract.

The real challenge here is to minimise faults and failures, as they can produce serious damages and far more expensive maintenance interventions, while optimally identifying the timing of maintenance events. Such an ideal approach is referred to as Autonomic Logistics Services (ALSs), where the maintenance program should

CNR - Isituto di Analisi dei Sistemi ed Informatica “A. Ruberti”, Roma, Italy, denicola@iasi.cnr.it, missikoff@iasi.cnr.it, tininini@iasi.cnr.it

not be scheduled "a priori" but dynamically derived on the bases of the operational status of the system.

As in many other business contexts, the methods commonly used to represent maintenance and logistics processes are mainly informal, aimed at supporting the enterprise organization at the human-communication level, rather than a formal, to guarantee advanced processing. Recently, the advent of efficient methods for business process (BP) modelling, such as BPMN [1] and Service Oriented Architectures, and formal knowledge representation, such as ontologies, pushed the research to propose a advanced solutions for ALS. Our work is along this line.

The rest of the paper is organized as follows. In section "BPAL: An Ontological Approach to Dynamic Process Modeling", we introduce the BPAL approach, its main components, and the issues related to process composition. In section "The Application of BPAL for a Semantic ALS Approach", we briefly introduce the ontological approach to ALS, while in section "Related Works", we briefly report the related works. Conclusions and future works are finally discussed in section "Conclusions".

BPAL: An Ontological Approach to Dynamic Process Modeling

Dynamic Process Composition is a very hard problem investigated for long time in a wide variety of contexts [2], in general with limited practical results. Here we intend to address the problem in a specific context, by using an ontological approach. An ontology is a complex structure with three main sections:

$$\text{Onto} = (\text{C}, \text{R}, \text{A}) \tag{1}$$

where there C is a set of unary concepts, R nary relations, and A a set of axioms over the two. To create an ontology of BP we need an ontological framework that provides the modeling constructs and a methodology. To this end we propose BPAL (Business Process Abstract ontology Language).

The primitives offered by BPAL have been defined starting from the business culture (e.g., referring to *activity, decision, role*), and essentially correspond also to BPMN constructs. The set of BPAL symbols constitute its *lexicon*, while the domain concepts, expressed as atomic formulae (atoms), represent a BPAL ontology. BPAL atoms can be combined to build an Abstract Diagram that, once validated with respect to the BPAL Axioms, becomes to an Abstract Process. An isomorphism can be defined between an abstract process and a BPMN process, the latter providing the diagrammatic representation of the former. The main components of the BPAL framework are:

- *BPAL atoms*, represented in the form of logical predicates, are the core of the BPAL ontological approach, used to model unary concepts and nary relations. A business process ontology is obtained by instantiating one or more BPAL Atoms.

As an example, unary predicates can be used to represent an action (e.g. "check the component voltage") or an actor (e.g. "maintenance service engineer"), while nary predicates can represent precedence relations among actions and decision steps, as well as messages exchanged between actions. Furthermore, special atoms are provided, enabling the user to express specialisation or *part-of* relations among concepts (Table 1).

- *BPAL diagram*, a set of BPAL Atoms constitute a BPAL (abstract) diagram. It is an intermediate product of the design process. It is not required to satisfy all the BPAL and Domain axioms (see below).
- *BPAL axioms*, representing the constraints that a BPAL Diagram must satisfy to be a valid BPAL Process. They are conceived starting from the guidelines for building a correct BPMN process. Then, we have specific domain axioms (e.g., a maintenance process cannot start without the required clearance.)
- *BPAL (abstract) process* is a BPAL Diagram that has been validated with respect to the BPAL Axioms. The validation is achieved by supplying the abstract diagram and the BPAL axioms to a reasoner (we are currently experimenting JTP and SWI-Prolog.)
- *BPAL application ontology*, which is a collection of BPAL Processes cooperating in a given application.

In the following sections we elaborate each component of the BPAL Framework in more detail.

BPAL Atoms

The following table sketchily reports the BPAL atoms. The arguments of the BPAL atoms are constants that represent concepts in an existing Core Business Ontology (CBO), built according to the OPAL methodology [3].

Besides domain predicates, BPAL offers development predicates, used during the BP definition process. A BPAL Process is *fully refined* only if each of its atoms can not be further decomposed or specialised. Finally, we have the two update operations *Assert* and *Retract* used to update a BP abstract diagram (Table 2).

To improve readability, multiple operations of the same sort can be compacted in a single operation on multiple arguments, e.g. *Assert* $([BP\_Atom_1, \ldots, BP\_Atom_n])$.

BPAL Diagrams and Processes

By using BPAL atoms it is possible to create an abstract diagram first and then, after its validation, a BPAL process. An abstract diagram is a set of BPAL atoms respecting the (very simple) formation rules. Below we illustrate (Fig. 1) an abstract diagram; the presentation is supported by a concrete diagram, drawn according to a BPMN style. The node labels are concepts in the CBO.

Table 1 BPAL atoms

Unary predicates	
act(_a)	A business activity, element of an abstract diagram
role(_x)	A business actor, involved with a given role in one or more activities
dec(_bexp)	A generic decision point. Its argument is a Boolean expression evaluated to {true, false}. It is used in the preliminary design phases when developing a BP with a stepwise refinement approach. In later phases, it will be substituted with one of the specific decision predicates (see below)
adec(_bexp), odec(_bexp)	Decision points representing a branching in the sequence flow, where the following paths will be executed in parallel or in alternative, respectively
cont(_obj)	An information structure. For instance a business document (e.g., purchaseOrder)
cxt(_obj)	A context, represented by a collection of information structures
Relational predicates	
prec(_act| _dec, _act| _dec)	A precedence relation between activities, decisions, or an activity and a decision
xdec(_bexp, _trueAct)	This is a decision where only one successor will receive the control, depending on the value of _bexp
iter(_startAct, _endAct, _bexp)	A subdiagram, having _startAct and _endAct as source and sink, respectively. It is repeated until the boolean expression _bexp evaluates to true
perf(_role, _act)	A relation that indicates which role(s) is dedicated to which activities
msg(_obj, _sourceNode, _destNode)	A message, characterized by a content (_obj), a sending activity (_sourceNode), and a receiving activity (_destNode)

Table 2 BPAL development predicates

Development predicates	
pof(_upre, _upre)	Part-of relation that applies to any unary predicate. It allows for a top-down decomposition of concepts
isa(_upre, _upre)	Specialization relation that applies to any unary predicate. It allows to build a hierarchy of BP concepts, supporting a top-down refinement
Editing operations	
Assert (BP_Atom)	It allows a new atom to be included in the ontology
Retract (BP_Atom)	It allows an existing atom to be removed from the ontology

The corresponding BPAL abstract diagram is the following.

act(a), act(b), act(c), act(d), act(e);
prec(a,b), prec(a,c), prec(c,d), prec(b,d), prec(d,e).

The BPAL Axioms

As anticipated, the BPAL framework supports the specification of axioms to be satisfied by a BPAL Process. A complete treatment of the BPAL axiomatic theory is beyond the scope of this paper. Here we provide a simple example to show the underlying philosophy.

Branching axiom
If a node is followed by two or more immediate successor activities, then it must be a decision

$$\forall x,y \in CBO : act(y) \wedge S(x) = \{y \in CBO\text{: } prec(x,y)\} \wedge |S(x)| > 1 \rightarrow dec(x)$$

According to the *Branching axiom*, the above process diagram is invalid and needs to be transformed into the following diagram:

act(a), act(b), act(c), act(d), act(e), dec(k);
prec(a,k), prec(k,b), prec(k,c), prec(c,d), prec(b,d), prec(d,e).

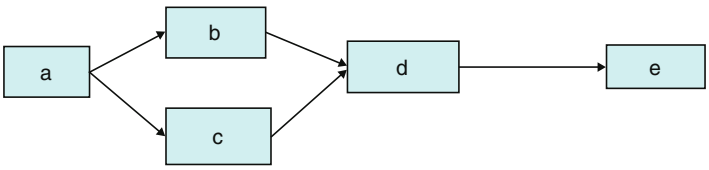


Fig. 1 A simple BPMN diagram

This transformation is obtained by a number of updates on the original BPAL abstract diagram, sketchily summarised as follows:

Assert([dec(k), prec(k,b), prec(k,c), prec(a,k)])
Retract ([prec(a,b), prec(a,c)])

Please note that we have now a Generic BPAL abstract process. It is a process since the axiom is not violated. However, it is *generic*, since there is a generic atom *dec(k)* that needs to be substituted with a specific atom (one of: *adec, odec, xdec*.) Such a substitution, assuming that in the refinement steps we discover that we need an *and* branching, will be achieved by the following operations:

Assert (adec(k))
Retract (dec(k))

Further steps of design refinement will involve other BPAL atoms, to fully specify roles, messages, etc. Once a BPAL abstract process has been defined and validated, it can be transformed into executable code. To this end, we follow the BPMN approach and its transformation to BPEL. A full elaboration of this part falls outside the scope of this paper.

The Application of BPAL for a Semantic ALS Approach

The method presented in this paper represents the core of the SALSA (Semantic Autonomic Logistics Services and Applications) system, aiming at an extensive application of Semantic Web solutions in the context of Autonomic Logistics services. In SALSA, we envisage a federation of ontologies needed to model: (a) Systems Architecture; (b) Failures and Malfunctioning; (c) Monitoring and Diagnostics; (d) Maintenance and Repairing. SALSA will include a reasoner, aiming at supporting a large part of the above operations and the overall consistency of the ontology federation. Furthermore, it will support the definition of logistics processes and their evolution and dynamic composition.

Related Works

Several languages for BP have been proposed in the literature. Such languages can be sketchily gathered in three large groups.

Descriptive languages. Produced by the business culture, they lack a systematic formalization, necessary to use an inference engine. In this group there are diagrammatic languages, such as EPC [4], IDEF [5, 6], and BPMN [1, 7]. Also UML-Activity Diagram [8] can be listed here, even if originally conceived for other purposes. The BPs defined with these languages are mainly conceived for inter-human communication and are not directly executable by a computer.

Procedural languages. They are fully executable by a computer but are not sufficiently intuitive for being used by humans, and lack a declarative semantics,

necessary to be processed by a reasoning engine. Examples of these languages are BPEL [9] and XPDL [7, 10].

Formal languages. They are based on rigorous mathematical foundations, but are difficult to be understood and are generally not accepted by business people. In this group we find several formalisms, e.g. PSL [11, 12], Pi-Calculus [13], Petri-Nets [14].

Finally, there are the *ontology-based process languages*, such as OWL-S [15], WISMO [16], and WSDL-S [17]. This group of languages have a wider scope, aiming at semantic modeling and execution of processes in an ontological context. Such ambitious proposals did not prove yet its effectiveness in real applications.

Conclusions

This paper has briefly introduced an ontological approach to BP modeling, with particular attention to advanced logistics processes. The proposal is based on BPAL, an abstract language that provides a formal background to a commercial emerging standard: BPMN. BPAL supports the construction of process ontologies in their three sections: concepts, relations, and axioms. The latter represent a key notion, necessary to build a semantically rich BP model; furthermore, with the help of a reasoner, a BPAL process can be formally validated. Finally, a BPAL ontology can be translated to BPEL and then, after some manual integration, executed on top of a BPEL Engine. This final phase is still in a preliminary stage and will absorb much of our future work.

References

1. OMG (2006). Business Process Modeling Notation Specification. Version 1.0. February 2006 www.bpmn.org/Documents/OMG%20Final%20Adopted%20BPMN%2010%20Spec%2006-02-01.pdf
2. Sivashanmugam, K., Miller, J., Sheth, A., and Verma, K. (2004). Framework for Semantic Web Process Composition. *International Journal of Electronic Commerce*, 9(2), 71–106
3. D'Antonio, F., Missikoff, M., and Taglino, F. (2007). Formalizing the OPAL eBusiness ontology design patterns with OWL. I-ESA Conference 2007
4. Scheer, A.-W., Thomas, O., and Adam, O. (2005). Process Modeling Using Event-Driven Process Chains. In Dumas, M., van der Aalst, W., and ter Hofstede, A.H.M. (eds). *Process-Aware Information Systems*. Wiley-Interscience, New York, Pages 119–145
5. IDEF. IDEF0 – Function Modeling Method. http://www.idef.com/IDEF0.html
6. IDEF. IDEF3 – Process Description Capture Method. http://www.idef.com/IDEF3. html
7. Mendling, J., zur Muehlen, M., and Price, A. (2005). Standards for Workflow Definition and Execution. In Dumas, M., van der Aalst, W., and ter Hofstede, A.H.M. (eds). *Process-Aware Information Systems*. Wiley-Interscience, New York, Pages 281–316
8. OMG (2007). Unified Modeling Language: Superstructure version 2.1.1. http://www.omg.org/docs/formal/07-02-03.pdf

9. Khalaf, R., Mukhi, N., Curbera, F., and Weerawarana, S. (2005). The Business Process Execution Language for Web Services. In Dumas, M., van der Aalst, W., and ter Hofstede, A.H.M. (eds). *Process-Aware Information Systems*. Wiley-Interscience, New York, Pages 317–342
10. WFMC (2005). Process Definition Interface – XML Process Definition Language, version 2.00. http://www.wfmc.org/standards/docs/TC-1025_xpdl_2_ 2005-10-03.pdf
11. Bock, C. and Gruninger, M. (2005). PSL: A Semantic Domain for Flow Models. *Software and Systems Modeling Journal*, 4, 209–231
12. Schlenoff, C., Gruninger, M., et al. (2000). The Process Specification Language (PSL) Overview and Version 1.0 Specification, NIST
13. Milner, R. (1999). *Communicating and Mobile Systems: the Pi-Calculus*. Cambridge University Press, ISBN 0-521-65869-1
14. Peterson, J.L. (1977). Petri Nets. *ACM Computing Surveys*, 9(3), 223–252
15. The OWL Services Coalition (2003). OWL-S: Semantic Markup for Web Services. http://www.daml.org/services/owl-s/1.0/owl-s.pdf
16. Roman, D., Keller, U., and Lausen, H., et al. (2005). Web Service Modeling Ontology. *Applied Ontology*, 1(1), 77–106
17. W3C (2005). Web Service Semantics – WSDL-S http://www.w3.org/Submission/WSDL-S

Knowledge Discovery and Classification of Cooperation Processes for Internetworked Enterprises

F. Folino[1], **G. Greco**[2], **A. Gualtieri**[3], **A. Guzzo**[3], **and L. Pontieri**[1]

Abstract The "internetworked" enterprise domain poses a challenge to IT researchers, due to the complexity and dynamicity of collaboration processes that are to be supported in such a scenario typically. A major issue in this context, where several entities are possibly involved that cooperate according to continuously evolving schemes, is to develop suitable knowledge discovery techniques to extract and restructure intra and interorganizational knowledge concerning the enactment of cooperation processes. Indeed, such techniques can effectively help to better understand, monitor and analyze the cooperation processes, as well as to rationalize future executions and to adapt them to continuous requirement changes. In this paper, we discuss some knowledge discovery techniques specifically addressed to the analysis of process logs, as well as their integration in a comprehensive architecture for managing both the cooperation processes and the associated knowledge and information in a distributed setting.

Introduction

The "internetworked" enterprise domain represents a challenging application scenario for IT research, due to the complexity and dynamicity of collaboration processes that are to be supported typically in such a context, based on some suitable elicitation, management and sharing of both intra and interorganizational information and knowledge. Such organizational schemes range from traditional collaborative work scenarios involving parts of the same organization, to

[1]CNR - ICAR, Rende, Italy, ffolino@icar.cnr.it, pontieri@icar.cnr.it
[2]Università della Calabria, Dipartimento di Matematica, Arcavacata di Rende, Cosenza, Italy, greco@mat.unical.it
[3]Università della Calabria, DEIS, Arcavacata di Rende, Cosenza, Italy, gualtieri@exeura.it, guzzo@deis.unical.it

supply-chains cooperation scenarios, to less predetermined and less structured cooperation schemes, like the ones arising in wide industrial districts.

In such a scenario, two goals are to be pursued in a synergic way:

1. The network of organizations and services must have a distributed and dynamic structure.
2. A strong integration at the semantic level is needed to guarantee application interoperability and to provide decision makers with a unified and high-level view over the processes.

The first objective can be effectively coped with by resorting to advanced platforms for distributed computing such as Grids and Service Oriented Architectures, which enable to define and enact cooperation processes based on pre-existing services and functional components, regardless of details about their actual implementation and deployment location.

Conversely, the second goal, which usually requires quite long and complex analysis tasks, can be supported by defining suitable knowledge discovery techniques to extract and restructure intra and interorganizational knowledge about cooperation processes, as well as to rationalize future executions and to adapt them to continuous requirement changes. In particular, one can take advantage of process mining techniques [1], recently appeared in the literature, which are meant to automatically extract new knowledge on the behavior of a process, based on data gathered during its past enactments and stored in suitable logs.

The rest of the paper is organized as follows. In section "Knowledge Discovery Techniques for Cooperation Processes", we discuss some process mining techniques that allow to extract high value knowledge on cooperation processes, in the form of workflow models and process taxonomies. Then, in section "A Service-Oriented Architecture for Cooperation", we sketch a service-oriented system architecture which supports the design, enactment and analysis of distributed cooperation processes, by integrating such advanced knowledge discovery mechanisms.

Knowledge Discovery Techniques for Cooperation Processes

Although there exists a plethora of languages for modelling a process, typical process mining approaches focus on *workflow* models, specifying process activities and routing constraints.

As an illustrative example, consider the toy HANDLEORDER process for managing customers' orders in a company, shown in Fig. 1. Here, edges represent precedence relationships, while additional constraints are expressed via labels associated with activity nodes. For example, task `l` is an AND-join activity, as it must be notified that both the client is reliable and the order can be supplied correctly. Conversely, `b` is a XOR-split activity, since it can activate just one of its adjacent activities.

Each time a workflow schema W is enacted, it produces an *instance*, i.e., a suitable sub-graph satisfying all constraints associated with W. Most process-oriented

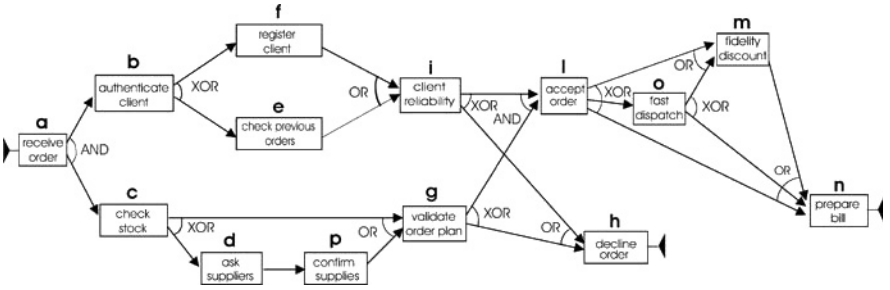


Fig. 1 Workflow schema for the sample HandleOrder process

systems typically store information on each process instance, by keeping track of the activities executed during that instance. Basically, a process log L can be seen as a set of *traces*, each of them simply consisting of a sequence of activities.

The rest of this section focuses on two different discovery approaches: the induction of a family of workflow models, and the discovery of process taxonomies.

Clustering-Based Discovery of Expressive Process Models

Given a workflow log L (i.e., a set of traces), the process mining problem consists in discovering a workflow schema that represents the traces registered in the log in a compact and accurate way. Two basic measures can evaluate the accuracy of a workflow schema W w.r.t. a log L: (a) *soundness*(W,L), i.e., the percentage of W's instances having some corresponding traces in L, and (b) *completeness*(W,L), i.e., the percentage of traces in L that are compliant with W.

While classical process mining techniques can well discover a model with maximal completeness, they usually get low values of soundness in the case of processes with complex dynamics. To address such a case, the approach proposed in [2] discovers a set of workflows, collectively named *disjunctive workflow schema*, which provide a modular and accurate representation of the process.

Roughly, the approach implements a hierarchical, top-down, clustering procedure, sketched by the algorithm `HierarchyDiscovery` shown in Fig. 2, where traces sharing a similar behavior are clustered together, and then equipped with a specialized schema, possibly obtained by using some classical process mining algorithm. At the end of the procedure, a hierarchy of workflow schema is obtained, whose leaves constitute a disjunctive schema for the log.

In order to efficiently partition a set of traces by well-known clustering methods, we resort to a "flat" relational representation of the traces, by projecting them onto suitable features, named *discriminant rules*, expressing behavioral patterns that are not modelled properly by the workflow schema that is being refined. More specifically, a *discriminant rules* is a rule of the from $[a_1 \ldots a_h] -/-> a$ such that:

- $[a_1 \ldots a_h]$ and $[a_h a]$ are both "highly" frequent (w.r.t. a given threshold σ)
- $[a_1 \ldots a_h\ a]$ is "lowly" frequent (its frequency is below a given threshold γ)

```
INPUT:    A log L, 2 numbers maxSplit and K, a threshold γ
OUTPUT:   A schema hierarchy H, and a disjunctive schema DW
Method:   Perform the following steps:
A) Init the hierarchy with a single workflow schema W0
A.1) W0 = mineWFSchema(L) // mine a single schema W0 for L
A.2) Cluster(W0)=L // associate W0 with the whole log L
A.3) initialize DW and H with the sole schema W0
B) WHILE size(DW)≤ maxSplit and soundness(DW)< γ
B.1) Select the the least sound schema W* in DW
B.2) Discover a set FS of discriminant rules from Traces(W*)
B.3) Project Traces(W*) on FS and partition the projected
     vectors by k-means into K clusters C1, …, CK
B.4) For each cluster Cj (j=1..k) mine a (refined) schema Wj,
     put it in DW, and add Wj as a child of W* in H
```

Fig. 2 Algorithm HierarchyDiscovery

For example, the rule `[fil]-/->m` captures the fact that, in process `HandleOrder`, a fidelity discount is never applied when a (new) client is registered.

We refer the interested reader to [2] for further details on the approach.

Discovery of Process Taxonomies

The usefulness of process taxonomies emerged in several applications, and process abstraction is currently supported in a few advanced platforms for business management. However, users are typically enabled to define relationships between the real process and the abstract views in a manual way. Therefore, such a platform could benefit from the insertion of tools for automatically deriving a description of the process at different abstraction levels, which would effectively support the reuse and semantical consolidation of process knowledge.

The approach proposed in [3] combines the clustering of log traces, performed as in section "Clustering-Based Discovery of Expressive Process Models", with ad-hoc abstraction techniques in order to produce a process taxonomy, where the root encodes the most abstract view on the process and any level of internal nodes refines this abstract model by adding more specific details.

Before illustrating the approach, we next introduce a few basic notions. We assume that an abstraction dictionary D, defined as tuple $D = \langle A, IsA, PartOf \rangle$, where A is a set of activities, while IsA and $PartOf$ are binary relations over A. Intuitively, given two activities a and b, $(b,a) \in IsA$ indicates that b specializes a, whereas $(b,a) \in PartOf$ indicates that b is a component of a. Moreover, we say that *a implies x* if there is a path from a to x in the graphs induced by IsA and $PartOf$. In such a case we also say that a is a *complex* activity; otherwise, a is a *basic* activity. In a sense, complex activities are high-level concepts defined by aggregating or generalizing basics activities actually occurring in real process executions.

```
INPUT: A schema hierarchy H
OUTPUT: The (modified) hierarchy H, and an abstraction
        dictionary D, s.t. H is a schema taxonomy w.r.t. D
Method: Perform the following steps:
1) Initialize the dictionary D as empty
2) Create a set S of schemas with the leaves of H
3) WHILE ∃ v in H, s.t. v∉S and all its children are in S
3.1) replace v with a new schema generalizing v's children
3.2) put v in S
4) Normalize D by removing "superfluous" activities
```

Fig. 3 Algorithm BuildTaxonomy

Given an abstraction dictionary D and a tree H of workflow schemas, we say that H is a *schema taxonomy* w.r.t. D if *Wp generalizes W*, for any pair of schemas W and Wp s.t. W is a children of Wp. The simple notion of generalization adopted here is as follows: Given two workflow schemas W_1 and W_2, we say that W_2 *specializes* W_1 (W_1 *generalizes* W_2) w.r.t. a given abstraction dictionary H, if for each activity a_2 of W_2 (a) either a_2 appears in W_1 or there exists an activity a_1 in W_1 such that a_1 *implies* a_2, and (b) there is no activity b_1 in W_1 such that a_2 *implies* b_1.

The approach for deriving a taxonomy of workflow schemas is sketched in Fig. 3. Here an algorithm, named `BuildTaxonomy` is shown that takes in input a schema hierarchy ***H*** (possibly extracted by the algorithm `HierarchyDiscovery`) and transforms it into a taxonomy that models the process at different levels of details; in addition, the algorithm updates an abstraction dictionary ***D*** in order to store all the abstraction relationships discovered.

In a bottom-up fashion, each non-leaf workflow schema v in the hierarchy is replaced with a new schema generalizing all the children of v. The basic idea to generalize a set of schemas consists in replacing groups of "specific" activities (i.e., activities that do not appear in all the schemas being generalized), with new "virtual" activities representing them at a higher abstraction level. In this way only the features that are shared by all the children of v are represented exactly, while other activities are abstracted into high-level (i.e., *complex*) activities. To this aim, after merging together the schemas to be generalized and their associated constraints, activities are iteratively abstracted into a complex one. This task tries to minimize the number of spurious flow links between the remaining activities, besides considering activities' mutual similarity w.r.t. the contents of ***D***.

As a result, a new generalized schema is computed and assigned to v while ***D*** is updated to suitably relate the activities that were abstracted with the complex ones that replaced them. Moreover, the dictionary ***D*** is restructured by removing any complex activity a that does not appear in any schema of ***H***, and is implied by another, higher-level, complex activity implying the same set of basic activities as a.

Further details on the technique can be found in [3].

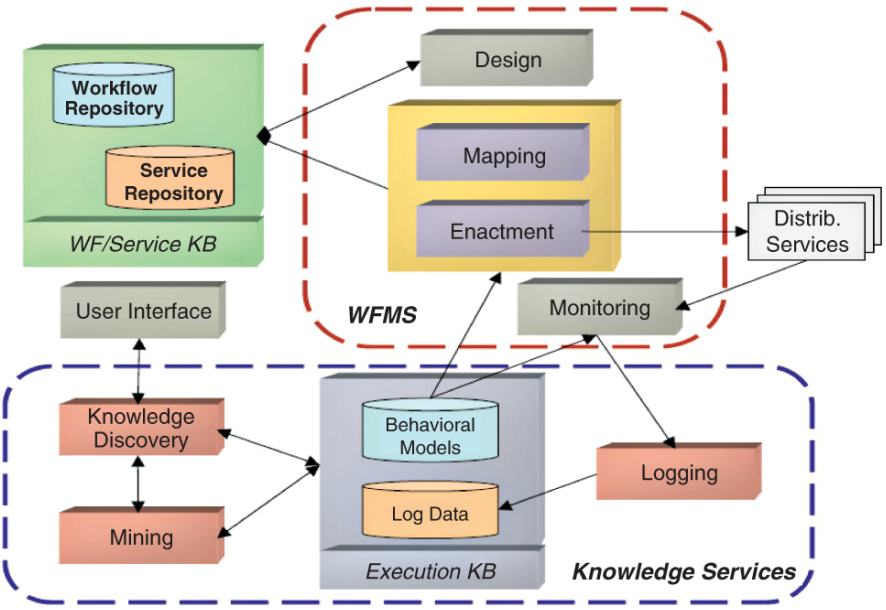


Fig. 4 A service-oriented architecture supporting distributed cooperation processes

A Service-Oriented Architecture for Cooperation

As mentioned in the introduction, the management of cooperation processes and the sharing of the associated information and knowledge can be effectively supported by means of a service-oriented grid platform, like the one proposed in [4]. Figure 4 shows the main features and functional components of this architecture.

In addition to usual functions for managing Grid workflows, the architecture features advanced services responsible for collecting, mining, and analysing data resulting from the enactment of cooperation processes. The final aim of these services is to generate new knowledge about the actual behavior of these processes which will be exploited to improve future design and execution tasks.

The design of a new workflow is usually accomplished from scratch by accessing a service directory, selecting useful services, and composing them using some workflow specification formalism. This task can be supported by information stored in the *WF/Service Knowledge Base (KB)*, built upon standard directory infrastructures, and providing a repository of available services and workflow processes. Interestingly, workflow schemas can be organized into taxonomies, defined manually or with the help of techniques like the one described in section “Discovery of Process Taxonomies”.

The *Execution Knowledge Base* manages two types of information on process executions: raw execution data, logged during the enactment of workflows, and higher-level knowledge derived from such data by data mining tools, and consisting of different kinds of behavioral models, including those discussed in section “Knowledge Discovery Techniques for Cooperation Processes”.

Logging services are devoted to register, into a suitable log repository, a trace for every workflow execution. Events of interest to be traced concern, e.g., the task that is being executed, values of parameters, the agent performing the task. The logging service handles the gathering and storing of all this data by interacting with basic monitoring services.

Monitoring services can be extended to provide, besides traditional performance metrics, high-level views on the execution status and application-oriented performance metrics, both defined on the basis of behavioral knowledge stored in the *Behavioral Model Repository*. For example, clustering models can be used for computing aggregated views over the current executions, at different levels of details. Moreover, predictive models can be exploited to predict erroneous or low-quality outcomes for on-going executions. Such a kind of real-time information can be used to generate alert events and stimulate repair actions.

Data Mining services allow to discover basic patterns (e.g., discriminant rules) and process models characterizing the actual behavior registered in the logged executions. They implement the algorithms presented in section "Knowledge Discovery Techniques for Cooperation Processes" as well as other classical mining techniques (association rules discovery, induction algorithms for classification and prediction models), and store their results in the *Behavioral Models repository*. Any such model is a valuable means for comprehending and analysing the actual behavior of a process. As an instance, schema hierarchies and taxonomies enable to recognize different variants of a given process and can provide hints for defining specific workflow models for some of them.

Knowledge Discovery services represent higher-level analysis services that enable the user to retrieve, query, and evaluate such mined patterns and models, in order to distillate interesting knowledge to be stored in the behavioral knowledge base. Moreover, they allow to analyse such "non-structural" patterns and models in comparison with "non-structural" information, encoding features of the logged traces that are beyond the path pursued throughout the workflow schema (e.g., invoked services and task parameters). Statistics correlation techniques and OLAP tools can be exploited to this purpose. Finally, by integrating these two different kinds of knowledge they make it possible to derive richer models, such as classification models or association rules that correlate the occurrence of a pattern with the value of performance metrics (e.g., total execution time, or quality of results).

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References

1. van der Aalst, W. M. P., van Dongen, B. F., Herbst, J., Maruster, L., Schimm, G., and Weijters, A. J. M. M. (2003). Workflow mining: A survey of issues and approaches. *Data & Knowledge Engineering*, 47(2): 237–267
2. Greco, G., Guzzo, A., Pontieri, L., and Saccà, D. (2006). Discovering expressive process models by clustering log traces. *IEEE Transactions on Knowledge and Data Engineering*, 18(8): 1010–1027

3. Greco, G., Guzzo, A., and Pontieri, L. (2005). Mining hierarchies of models: from abstract views to concrete specifications. In *Proceedings of the 3rd International Conference on Business Process Management* (pages 32–47). Springer, Berlin
4. Congiusta, A., Greco, G., Guzzo, A., Pontieri, L., Manco, G., Saccà, D., and Talia, D. (2005) A data mining-based framework for grid workflow management. In *Proceedings. of the 5th International Conference on Quality Software* (pages 349–356). IEEE Computer Society

Knowledge-Oriented Technologies for the Integration of Networked Enterprises

M. Lenzerini[1], U. Carletti[2], P. Ciancarini[3], N. Guarino[4], E. Mollona[3], U. Montanari[5], P. Naggar[6], D. Saccà[7], M. Sebastianis[8], and D. Talia[9]

Abstract TOCAI.IT is an on-going Italian 3-year project, funded by the Ministry of Universities and Scientific Research under the FIRB program for the basic research, aimed at developing an integrated group of methodologies, techniques and software systems based on the most advanced knowledge technologies for the on-the-field analysis, specification, implementation and evaluation of new enterprise organization models in the "internetworked enterprise" perspective. This paper describes the goals and activities of the project and its progress after 1 year from the start.

Introduction

TOCAI.IT "*Tecnologie Orientate alla Conoscenza per Aggregazioni di Imprese in INTERNET*" (Knowledge oriented technologies for Enterprise Integration in INTERNET) is an on-going Italian project funded by the Ministry of Universities and Scientific Research under the FIRB program for the basic research. The project has a duration of 36 months and involves:

– Two academic partners: *CINI* and *CNR*, that coordinate several research teams coming from Universities and CNR institutes, respectively, and gather high level

[1]Università di Roma "La Sapienza", Dipartimento di Informatica e Sistemistica "Antonio Ruberti", Roma, Italy
[2]SELEX Sistemi Integrati SpA, Stabilimento Fusaro, Bacoli (NA), Italy
[3]Università di Bologna, Dipartimento di Scienze dell'Informazione, Bologna, Italy
[4]CNR - ISTC, Trento, Italy
[5]Università di Pisa, Dipartimento di Informatica, Pisa, Italy
[6]CM Sistemi SpA, Roma, Italy
[7]Università della Calabria, Arcavacata di Rende, Cosenza, Italy, sacca@unical.it; CNR - ICAR, Rende, Italy, sacca@icar.cnr.it
[8]THINK3 Inc., Casalecchio di Reno (BO), Italy
[9]Università della Calabria, DEIS, Via P. Bucci 41C, 87036 Rende, Italy

scientific skills in the field of science and information technologies, with particular consideration to process and knowledge modelling.
– Three industrial partners: *CM*, *SELEX* and *THINK3*; each of them contributes to the project with their high level industrial skills and relevant experiences in one of the cooperation scenarios among innovative enterprises analysed in the project.

The aim of the project is to develop an integrated group of methodologies, techniques and software systems based on the most advanced knowledge technologies for the on-the-field analysis, specification, implementation and evaluation of new enterprise organization models in the "internetworked enterprise" perspective. For this perspective to be successful, two potentially competing aspects should be harmonized:

- On the one hand, the network of organizations and services must have a distributed and dynamic structure.
- On the other hand, a strong integration at the semantic level is instrumental to guarantee an effective application-level interoperability and, above all, to offer decision makers the holistic, unified view which is needed to effectively evaluate, implement, and control all strategic and tactic decisions.

The challenging goal of this project is to show that a synthesis of the two aspects mentioned above is possible in practice, in particular within the context of the Italian productive system. With this aim, three technology-aware enterprises have been chosen as active participants in the project, each of them representing a different kind of innovative organization model:

- The *intraenterprise integration model*, focusing on the concurrent manufacturing approach. This model embraces the situations in which elements of an enterprise (or of several enterprises with strong synergy) collaborate to produce a particular product.
- The *interenterprise integration model*, at the supply-chain level. In this case enterprises of different types interact within the supply-chain paradigm.
- The *district-level cooperation and interoperability model*. In comparison to the previous models, here the interaction among the subjects which are active in the district is largely unpredictable and unstructured.

In the project, these case-studies are analyzed under a unifying perspective based on different integration levels, both at the intra and interenterprise level, which are orthogonal with respect to the previous models: product data integration (addressing different viewpoints and aspects of product knowledge), workflow integration (among different services and processes), organization integration (among services and organizations, among different parts of the same enterprise, among different enterprises), strategic integration (between the enterprise and its external environment).

Beyond the pure scientific goals, the project aims at contributing to strengthen and integrate a good number of prestigious research centers operating both in universities and in public research institutions, as well as a few selected private companies who will be enabled to play a leading role in fostering further innovation. The challenge is to isolate a coherent set of advanced methodologies and solutions suitable

for the three case-studies, overcoming the limits and the fragmentation of currently available enterprise integration products and services (such as ERP systems), and fostering a new enterprise culture, aware of the potentialities and instruments of knowledge technologies.

This paper presents the goals and activities of the project and its progress after 1 year from the start. In particular section, "Architecture and Tasks of TOCAI.IT" describes the overall organization of the project into three levels and ten tasks and section, "Progress of the Project on the First Year" reports on the progress of the project after 1 year from its start.

Architecture and Tasks of TOCAI.IT

The project is characterized by a multi-level structure, where each level presents strongly innovative aspects (a further and substantial innovation element is implied by the combination and the mutual interaction of such levels):

1. The *first level concerns the economic analysis* of the considered organization models and the evaluation of the impact of the corresponding technological solutions. For the purpose of the impact evaluation, an agent-based simulation model is adopted, which reconstructs macroscopic phenomenon starting from agents' interaction with predefined operating rules and capacities. Special attention is devoted to the analysis of the legal problems related to the different organizational models.
2. The *second level concerns the three domain*s. The requirement analysis of the three case-studies aim at highlighting the collaborative nature of the relations between the different actors involved. Similarities and complementarities within the three domains will be underlined through an analysis of the different kinds of mutual relations and dependencies, by using a common goal-based approach.
3. The *third level is the one of integration*, which in turn is organized into sub-levels:
   (a) Conceptual modeling based on ontological and linguistic analysis. The main goal here is to develop a number of general, rigorous and well-founded business models (core-ontologies), to be used to enable comparison and semantic integration of pre-existing models of services and organizations.
   (b) Top-down specification of processes, data and services, including their modalities of dynamic integration and composition. The focus here is on providing suitable computational implementations for the conceptual models produced at the previous level. To this purpose, a coordination language for processes and services has been defined, in order to allow the check of functional and non-functional properties. Moreover, models, techniques and architectures for the dynamic integration and coordination of elementary services are under study, with the goal of providing a virtual composite service offering a transparent interface to data and services.
   (c) Bottom-up discovering of the most relevant process execution patterns (workflow mining), based on knowledge discovery and data mining techniques. We

argue that such a bottom-up discovering activity allows better understanding the dynamics of cooperation and knowledge-sharing modes in organizations, and to adapt them to the evolution of requirements, as well as to characterize critical states or anomalies. These techniques prove to be particularly relevant in a context where various organizations are involved and need to cooperate on continuously changing patterns. An important role in this context will be played by the privacy-preserving data mining techniques, to address the dichotomy between an increased interest in data sharing and a higher attention to privacy.

4. The *fourth level is the one of network infrastructure*, whose goal is to define Grid-based cooperative platforms for sharing services and resources, including advanced mechanisms to integrate cooperative communication tools with other software components, and guaranteeing a safe access to data and services.

The project, coordinated by Maurizio Lenzerini (CINI), is organized in ten research tasks:

- TASK1: *Analysis and mapping of the ICT impact on the interchanges of the inter and intraorganizational knowledge* – Coordinator: Prof. *Edoardo Mollona* (CINI) – Objective: to study the economic contexts in which the organizations interact integrating knowledge and processes, to propose and evaluate new business models in a perspective of "internetworked enterprise"
- TASK2: *Requirements analysis of the thee application scenarios* –Coordinator: Prof. *Paolo Ciancarini* (CINI) – Objective: to model and analyse through specific formalism the requirements regarding the three domains under examination
- TASK3: *Integration and specialization of technological solutions and scientific results with an approach to services for the intraorganisation domain (the collaborative work)* – Coordinator: dott. *Maurizio Sebastianis* (THINK3) – Objective: To detect and integrate those technologies able to integrate the functionalities of collaborative CAD environments with reference to a distributed architecture
- TASK4: *Integration and specialization of technological solutions and scientific results with an approach to services for the interorganisation domain within the supply-chains* – Coordinator: dott. *Ubaldo Carletti* (SELEX) – Objective: To detect and integrate technologies to support supply-chain in logistic domain with complex aspects related to the packing difficulty, to legal constraints, of political and environments security, to rigid timing delivery
- TASK5: *Integration and specialization of technological solutions and scientific results with an approach to services for the interorganisation domain within industrial districts* – Coordinator: dott. *Paolo Naggar* (CM) – Objective: to adopt and integrate methods, models and instruments able to support the aggregation of service needs that rise in the ambit of an industrial district characterized by the presence of a mediation element responsible of the aggregation need process
- TASK6: *Modelling and representation of the business knowledge based on the natural language* – Coordinator: dott. *Nicola Guarino* (CNR) – Objective: to define and develop a set of core ontologies for business modelling in an integrated intra and interbusiness perspective, to validate with reference to three domains and to support methodologies, techniques and software instruments for the

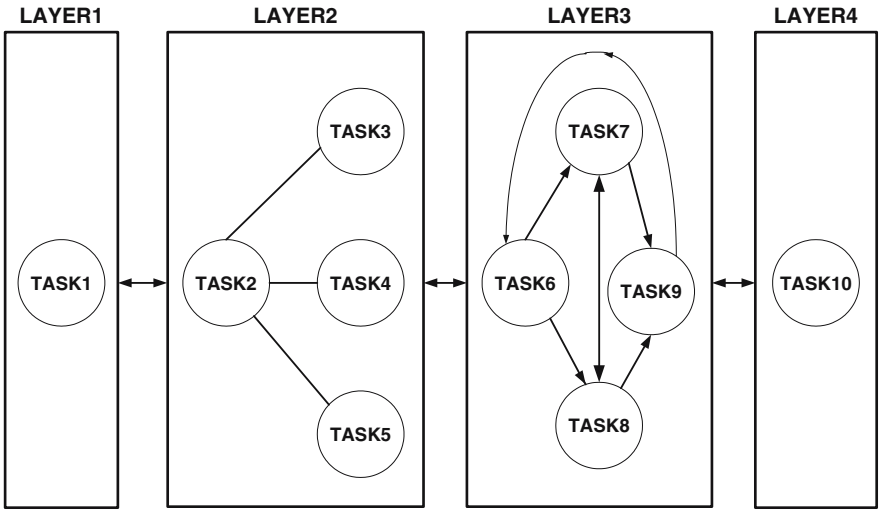


Fig. 1 Layers and relationships among task

requirement analysis and conceptual modelling of the organization guided for the analysis of the natural languages

- TASK7: *Specification and realization environments for process-oriented collaborative applications* – Coordinator: Prof. *Ugo Montanari* (CINI) – Objective: to elaborate the theoretical foundations for process and service specifications and their aggregations, following the most recent development directions for process and service oriented computing
- TASK8: *Cooperative models and tools for data and service integration* – Coordinator: Prof. *Maurizio Lenzerini* (CINI) – Objective: to develop models, techniques and architectures through which a set of base service components or a set of data sources can be integrated and coordinated to offer to the customer a virtual composite service on which to operate in a clear manner
- TASK9: *Discovery and classification of intra and interorganizational processes and knowledge* – Coordinator: Prof. *Domenico Saccà* (CNR) – Objective: to elaborate Knowledge Discovery (process mining, collaborative data mining) techniques for the discovery and classification of intra and interenterprise processes and knowledge to understand how the cooperation is realized and the knowledge is shared, and to eventually modify them according to changes of requirements
- TASK10: *Grid and platforms oriented to services for collaborative and distributed environments* – Coordinator: Prof. *Domenico Talia* (CINI) – Objective: to define grid systems and distributed platforms to support the management of data and users in collaborative and distributed environments with the consideration to authentication problems, authorization and integrity related to the data access and utilization of multi-channel communication platforms to improve the interaction and exchange of information in the context of collaborative working

The organization of the tasks in layers and their interactions are shown in Fig. 1.

Progress of the Project on the First Year

During the first year, TASK1 has addressed the economic impact of ICT on organizations, and more specifically has investigated how ICT influence economic organisation within a firm and among firms. Cooperation and coordination problems have been deeply investigated and mapped in the context of the three domains of interest. Key concepts for such problems such as product, evaluation criteria and protocols have been analyzed for the three domains using a shared conceptual background and a common language.

TASK2 has selected the specification language for early requirements and the requirements elicitation process. The language for specifying requirements adopted is the SI* modeling framework [1]. SI* is used by the Secure Tropos methodology [2] to model security and privacy aspects of the system-to-be and its environmental setting. SI* recognizes the need for modelling the coordination of organizational structures in terms of a set of stakeholders achieving common goals. The language has been used for modelling the cooperation and coordination requirements for the three domains.

Within TASKS 3, 4, and 5, the industrial partners have deeply investigated the cooperation requirements for the three domains of their interest, in particular:

- THINK3 has identified innovative scenarios and requirements for production processes of SMEs in the manufacturing sector, using collaborative CAD or concurrent engineering tools – these processes require fast and efficient management of a large amount of information, mainly documents to be exchanged.
- SELEX has focused on logistics of a large-scale manufacturing industry, namely SELEX itself, providing high-tech industrial products for demanding applications, including military ones, for which very complex problems have to be taken into account, such as: the difficulty of packing the product; legal constraints; environmental and politics security; very timely delivery, strict control of the supply chain and others.
- CM has investigated various problems of competition and collaboration within an industrial district, ranging from formal subcontracting to informal communications that foster innovation and entrepreneurship, and has defined a cooperation system able to facilitate both the contacts among industries within a district and the negotiation processes.

TASK6, dealing with the usage of ontology for the description of organizations (i.e., designed complex social entities governed by norms), in the first year has analyzed the ontological status of organizations and has produced sound and stable foundations for a model of the enterprise as an organization and of the enterprise as an element of a business network. The approach follows the one proposed by [3], which at the level of organizational design considers both roles and sub-organizations as atomic elements.

TASK7 is elaborating the theoretical foundations for process and service specifications and their aggregations, following the most recent development directions for process and service oriented computing. The work is structured in various

subtasks: Long Running Transaction [4], Quality of Service [5], Service Adaptation [6], Analysis and Verification [7], Workflow Languages [8].

TASK8 has investigated the state of the art about the issues concerned with Cooperation models and tools for the integration of data and services' and has also provided a first proposal on the languages and the formalisms to be used for the task purposes, following the approach of [9]. Techniques relying on these languages and formalisms will be then developed in the second and third year of the TOCAI project.

TASK9 has focused on the issues of knowledge discovery as well as classification of cooperation processes and intra/interorganizational knowledge. Indeed, the ultimate goal of this activity is to develop methodologies and tools that are able to elaborate the data actually produced and the processes realized in order to provide feedback to the phase of requirement analysis. In line with this scenario, knowledge discovery techniques have been developed covering two main topics: Process Oriented Knowledge Discovery [10] and Privacy Preservation in a Collaborative Distributed Knowledge Discovery Context [11].

Finally TASK10 has carried out research activities in scientific areas such as Grid services for data management and data analysis, distribute middleware for application integration, and services for mobile devices [12]. At the same time, it has been defined the application scenario where those technologies can be used, in particular it has been investigated the use of Grid-based and service-based architectures for supply and management of complex systems.

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References

1. Massacci, F., Mylopoulos J., & Zannone N. (2007). An Ontology for Secure Socio-Technical Systems. In *Handbook of Ontologies for Business Interaction*. The IDEA Group, Hershey
2. Giorgini, P., Massacci, F., & Zannone N. (2005). Security and Trust Requirements Engineering. In FOSAD 2004/2005, volume 3655 of LNCS, pages 237–272. Springer, Berlin
3. Bottazzi, E. & Ferrario, R. (2006). Preliminaries to a DOLCE Ontology of Organizations. *International Journal of Business Process Integration and Management*
4. Bruni R., Melgratti H., & Montanari, U. (2007). Composing transactional services, 2007, Submitted to http://www.di.unipi.it/bruni/publications/ejoinrevista.ps.gz
5. Buscemi, M. G., & Montanari, U. (2007). Cc-pi: A constraint-based language for specifying service level agreements. In Proceedings of ESOP 2007, 16th European Symposium on Programming, volume 4421 of Lecture Notes in Computer Science Springer, Berlin
6. Bonchi, F., Brogi, A., Corfini, S., & Gadducci, F. (2007). A behavioural congruence for web services. In *Fundamentals of Software Engineering, Lecture Notes in Computer Science*. Springer, Berlin
7. De Nicola, R., Katoen, J.-P., Latella, D., Loreti, M., & Massink, M. (2007). Model Checking Mobile Stochastic Logic. Theoretical Computer Science. Elsevier, 382(1): 42–70.

8. Abeti, L., Ciancarini, P., & Moretti, R. (2007). Model driven development of ontology-based grid services, 16th IEEE International Workshops on Enabling Technologies: Infrastructures for Collaborative Enterprises, WETICE 2007, Paris, France, June 18–20
9. Calvanese, D., De Giacomo, G., Lembo, D., Lenzerini, M., & Rosati, R. (2007). Tractable reasoning and efficient query answering in description logics: The DL-Lite family. *J. of Automated Reasoning*, 39(3): 385–429.
10. Greco, G. Guzzo, A., Pontieri, L., & Saccà, D. (2006). Discovering expressive process models by clustering log traces. IEEE Transactions on Knowledge and Data Engineering, 18(8):1010–1027
11. Atzori, M., Bonchi, F., Giannotti, F., & Pedreschi, D. (2006): Towards low-perturbation anonymity preserving pattern discovery, 21th ACM Symposium on Applied Computing (SAC-06) Dijon, France, April 23–27: 588–592
12. Talia, D. (2002). The Open Grid Services Architecture: Where the Grid Meets the Web, *IEEE Internet Computing*, 6(6):67–71

Sub-Symbolic Knowledge Representation for Evocative Chat-Bots

G. Pilato[1], A. Augello[2], G. Vassallo[2], and S. Gaglio[1,2]

Abstract A sub-symbolic knowledge representation oriented to the enhancement of chat bot interaction is proposed. The result of the technique is the introduction of a semantic sub-symbolic layer to a traditional ontology-based knowledge representation. This layer is obtained mapping the ontology concepts into a semantic space built through Latent Semantic Analysis (LSA) technique and it is embedded into a conversational agent. This choice leads to a chat-bot with "evocative" capabilities whose knowledge representation framework is composed of two areas: the rational and the evocative one. As a standard ontology we have chosen the well-founded WordNet lexical dictionary, while as chat-bot the ALICE architecture. Experimental trials involving four lexical categories of WordNet have been conducted, and an example of interaction is shown at the end of the paper.

Introduction

In last years there has been a great deal of research in order to integrate symbolic and sub-symbolic approaches, most of the time in solving learning problems [1]. At the same time there has been a growing interest towards the development of intelligent user interfaces (chat-bots) that can help people during the interaction with a system in a natural and intuitive manner. One of the most known chat-bot technology is ALICE [2], whose knowledge base is composed by question answer modules, called categories and described by the AIML language. This kind of interfaces can be improved through the integration of more sophisticated techniques [2, 3].

In this paper we analyze the possibility of applying LSA [4] to a traditional, ontology-based knowledge representation, in order to design an evocative reasoning module that can be embedded in a conversational agent.

[1]CNR - ICAR, Palermo, Italy, g.pilato@icar.cnr.it, gaglio@unipa.it
[2]Università degli Studi di Palermo, DINFO, Dipartimento di Ingegneria Informatica, Palermo, Italy, augello@csai.unipa.it, gvassallo@unipa.it

As ontology we have used the WordNet lexical dictionary [5], which is one of the most widely used "standard" ontologies. The evocative sub-symbolic layer is obtained through mapping WordNet entries as vectors in a semantic space. As a consequence, two generic terms of the ontology will be interconnected with a weighted link whose value indicates their reciprocal "evocation" strength.

The semantic space is created starting from an ad hoc created text corpus. We have considered a set of terms, and for each of them the explicit definitions and relations of WordNet with particular regard to synonymy and hypernymy. We have created a semantic space applying the LSA methodology to a normalized co-occurrence matrix between the terms and the aforementioned definitions and relations. An evocative module has then been integrated with the knowledge base of the chatbot, made of both the WordNet lexical dictionary and its AIML categories. The evocative module computes the semantic similarity between what is said by the user and the concepts of the ontology or the semantic similarity between two concepts already present in the ontology.

As a result, the conversational agent can dialogue with the user exploiting its standard knowledge base and it can also properly explore the WordNet dictionary in order to better understand the user queries. Furthermore, the conversational agent can exploit the evocative module, attempting to retrieve semantic relations between ontological concepts that are not easily reachable by means of the traditional ontology exploration.

The method has been preliminary tested on four lexical categories of WordNet ("*Animal*", "*Body Part*", "*Vehicle*" and "*Location*"). An example of interaction is reported at the end of the paper.

The Evocative Chat-bot Framework

The system framework is illustrated in Fig. 1. The chat-bot can interact with two main areas. The first one is a "rational area"; it is made of structured knowledge bases (the WordNet [5] ontology and the standard knowledge base of the chat-bot composed of AIML categories [2]). The second one is an "evocative area"; it is made of a semantic space in which ontology concepts, AIML categories and user queries are mapped.

Rational Area

The rational area consists of two kinds of structured knowledge bases the chat-bot can use: the ontology given by the well-founded WordNet lexical database and the chatbot Knowledge Base.

WordNet can be described as a set of lexical terms organized in a semantic net. Each node represents a *synset*, a set of terms with similar meaning. A synset is characterized by a *gloss*, that may contain a short definition and, in some cases, also one or more example sentences. Each arc is a semantic or lexical relation between

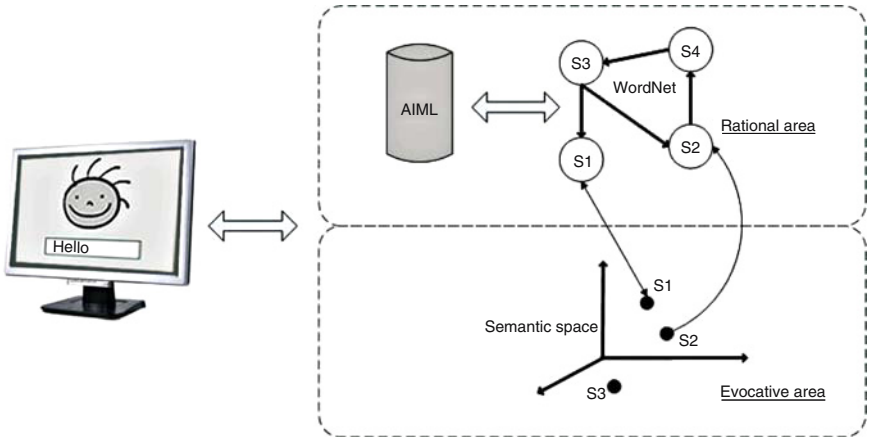


Fig. 1 The evocative Chat-bot architecture

synsets. The relations are characterized by a hierarchical structure. In fact a hypernymy relation connects each synset with his higher synset. A synset s_1 is hypernym of the synset s_2 if s_1 conceptually includes s_2. Each synset has at least one common hypernym with all the others. The root of this hierarchy is the concept *Entity*.

The conversational agent has been developed using the A.L.I.C.E. (Artificial Linguistic Internet Computer Entity) technology. The A.L.I.C.E chat-bot's knowledge base is composed of question-answer modules, called categories and structured with AIML (Artificial Intelligence Mark-up Language) an XML-like language [2]. The question, or stimulus, is described by the tag *pattern* while the answer by the tag *template*. Other tags allow managing also complex answers. The dialogue is based on algorithms for automatic detection of patterns in the dialogue data (*pattern matching*).

In order to explore the structure of WordNet we have introduced new, ad hoc AIML tags which allow the chat-bot to extract for a specific synset its gloss (tag *gloss)*, its hypernyms (tag *istanceOf)*, its meronyms (tag *hasPart*), its olonyms (tag *memberOf)*, and so on.

Evocative Area

The evocative area consists in a sub-symbolic semantic layer added to WordNet. This layer is obtained encoding WordNet entries as vectors in a semantic space created by means of LSA application.

Four lexical categories of WordNet ("Noun.Animal", "Noun.body", "Noun. artifact" and "Noun.location"), have been considered [6]. For each term belonging to each one of these categories we analyzed its WordNet definitions and relations. Considering a term w having Vw senses, we extracted the set of its synsets $\{S_i, i = 1, \ldots, V_w\}$ and their corresponding glosses $\{G_i, i = 1, \ldots, V_w\}$. We associated to w a set of "documents" $\{S_i + G_i\ i = 1, \ldots, V_w\}$ composed of the terms

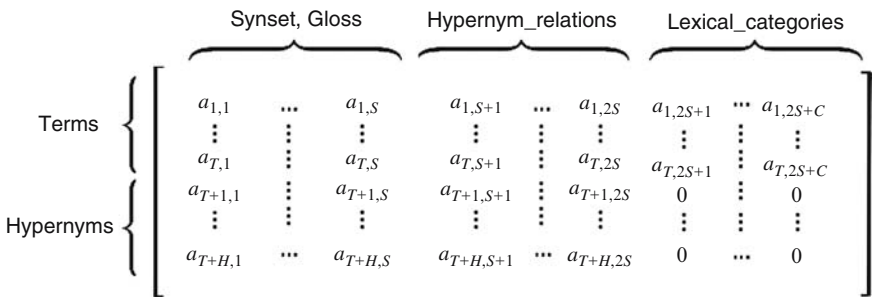


Fig. 2 Terms-documents matrix A: T, H, S and C are respectively the numbers of terms, hypernyms, senses and lexical categories

belonging to the synset and the sentence representing the gloss. For each synset Si, we built a "document" Hi composed of the set of all its hypernyms. Finally we associated to each synset belonging to one of the analyzed lexical categories another document L composed of terms of its own lexical category.

For each extracted hypernym a set of "documents" $(S_i + G_i)$ has been also considered. This set of texts has then been processed. Adverbs and articles, syntactic elements that could determine useless co-occurrence between terms, have been removed from the set. Afterwards a morphological analysis has been performed using the WordNet morphological processor. Each inflected form of the language is therefore reduced to its base form.

Let N be the number of documents of the text corpus previously built, and let M be the number of words belonging to the vocabulary, which are the terms chosen for the experiment together with their hypernyms. We build a $M \times N$ matrix $A = \{a_{ij}\}$ whose (i,j)-th entry is the (not normalized) occurrence frequency of the ith word in the jth context. The matrix is shown in Fig. 2.

For simplicity in the figure we indicate with "*Synset,Gloss*" all the sets of documents built from the synsets and the glosses associated to the vocabulary terms; with "*Hypernymy Relation*" all the sets of documents built from the hypernymy relations of each term and, finally, with "*Lexical Categories*" all the set of documents built from the lexical categories of each term. The words in the vocabulary are divided in *Terms*, which are the terms chosen at the beginning of the procedure, and *Hypernyms* which are their related hypernyms.

The matrix A is normalized to consider it as a sample set. We subsequently extract the square root of each element a_{ij}, and perform a Truncated Singular Value Decomposition (TSVD) [4] with a number of singular values R obtaining a matrix A_R, equal to:

$$A_R = U_R \sum\nolimits_R V_R^T \tag{1}$$

The matrix $\mathbf{A_R}$ is best rank R approximation of the matrix $\mathbf{A}$ with respect to the *Hellinger* distance, defined by:

$$d_H(A, A_R) = \sqrt{\sum_{i=1}^{M}\sum_{j=1}^{N}\left(\sqrt{a_{ij}} - \sqrt{a_{ij}^{(R)}}\right)} \tag{2}$$

The rows of the matrix $\mathbf{U_R}$ represent the coding of the words in the semantic space. To evaluate the distance between two vectors $\mathbf{u}_i$ and $\mathbf{u}_j$ belonging to this space which is coherent with this probabilistic interpretation, a similarity measure is defined as follows [7]:

$$sim(u_i, u_j) = \begin{cases} \cos^2(u_i, u_j) & \text{if} \cos(u_i, u_j) \geq 0 \\ 0 & \text{otherwise} \end{cases} \tag{3}$$

The use of $cos^2()$ is justified by the fact that the (i,j)-th entry of the matrix is the square root of the sample occurrence probability of the word i in the document j. Setting the similarity to 0 when the cosine is negative is a conservative choice.

Given a vector ui, associated to the word w_i, the set TR of vectors u_j, associated to the terms w_j and sub-symbolically conceptually related to the term w_i are evaluated according to this formula:

$$TR = \left\{ u_j \left| sim(u_j, u_i) \geq T \right. \right\} \tag{4}$$

where T is a threshold value experimentally determined. The chat-bot exploits the semantic layer trying to retrieve semantic relations between ontological concepts that are not reachable by means of the classical WordNet ontology exploration tools. As a matter of fact, the evocative conversational agent can evaluate the similarity of the coding corresponding to a term, a concept, or a sentence introduced by the user during the conversation with other concepts coded in the semantic space. The chat-bot will evocate particular concepts during the dialogue, making a smarter and satisfactory dialogue or even autonomously change the topic conversation by means of the detected relations.

An Example of Interaction

In this paragraph we report some examples of ad hoc AIML categories created in order to exploit the new sub-symbolic knowledge representation. The following category, related to the topic "*Animal*" allows the chat-bot to understand information requests about a topic.

```
<topic name=''animal''>
  <category>
    <pattern>CAN YOU TALK ME ABOUT *</pattern>
    <template><srai>INFO<think><set
    name='WNterm'><star/></set></think></srai></template>
  </category>
</topic>
  <category>
    <pattern>INFO</pattern>
    <template>It is<gloss/>It is a member of the
    class<memberOf/>. It has got
    a<gloss><hasPart/></gloss></template>
  </category>
```

The topic is generic and is matched with the wildcard *. Its value can be recovered through the tag *star*. The variable '*WNterm*' is set to the value of the topic and hidden to the user by means of the tag *think*. This category recursively calls the category with pattern equals to INFO by means of the tag *srai*. The category allows the chat-bot to collect information about the term stored into the *WNterm* variable: the gloss corresponding to the first synset of the term with the respective holonym and the gloss of its meronym.

The next category allows the chat-bot to exploit the sub-symbolic semantic layer in order to search in WordNet concepts semantically related to the term stored in the *WNterm* variable.

```
<category>
  <pattern>Can you talk me about some related topics?
  </pattern>
  <template><think><set
  name='WNterm'><relatedTerm/></think><srai>RANDOM
  SENTENCE ABOUT<istanceOf/></srai></template>
</category>
```

The chat-bot searches a topic related to the current one and sets it as new value of the '*WNterm*' variable, then detects its hypernym in order to understand what kind of instance represents the term. It therefore recursively calls another category which randomly selects a sentence specific for its instance type.

The following dialogue shows a possible interaction with the chat-bot derived from the categories previously analyzed.

U: Can you talk me about lion?
C: It is a large gregarious predatory feline of Africa and India having a tawny coat with a shaggy mane in the male. It is a kind of big cat. It is a member of the class Panthera, genus Panthera. It has got a long coarse hair growing from the crest of the animal's neck.
U: Can you talk me about some related topics?
C: Yes, have you ever been in Africa?
U: No, tell me something about it.
C: It is the second largest continent; located south of Europe and bordered to the west by the South Atlantic and to the east by the Indian Ocean ...

Conclusion and Future Work

In this work we have exploited a sub-symbolic technique that allows the introduction of an evocative semantic layer to a traditional ontology-based knowledge representation. This solution leads to chat-bots with both reasoning and evocative/associative capabilities allowing a smarter, nontrivial and more satisfactory dialogue with the user. Future work will regard the extension of the corpus with the remaining WordNet semantic relations, such as antinomy and meronymy, and the expansion of the set of concepts to the entire WordNet.

References

1. Pilato, G., Augello, A., Trecarichi, G., Vassallo, G., & Gaglio, S. (2005). LSA-Enhanced Ontologies for Information Exploration System on Cultural Heritage. *AIIA Workshop for Cultural Heritage*. University of Milan Bicocca, Milano, Italy
2. Alice: http://www.alicebot.org
3. Goh, O. S., Ardil, C., Wong, W., & Fung, C. C. (2006). A Black-Box Approach for Response Quality Evaluation Conversational Agent System. *International Journal of Computational Intelligence*. Vol. 3, 195–203
4. Landauer, T. K., Foltz, P. W., & Laham, D. (1998). Introduction to Latent Semantic Analysis. *Discourse Processes*. Vol. 25, 259–284
5. Miller, G. A., Beckwidth, R., Fellbaum, C., Gross, D., & Miller, K. J. (1990). Introduction to WordNet: An On-line Lexical Database. *International Journal of Lexicography*. Vol. 3 N. 4, 235–244
6. Patwardhan, S. & Pedersen, T. (2006). Using WordNet-based Context Vectors to Estimate the Semantic Relatedness of Concepts. *Proceedings of the EACL 2006 Workshop Making Sense of Sense – Bringing Computational Linguistics and Psycholinguistics Together*. Trento, Italy, pp. 1–8
7. Agostaro, F., Pilato, G., Vassallo, G., & Gaglio, S. (2005). A Subsymbolic Approach to Word Modelling for Domain Specific Speech Recognition. *Proceedings of IEEE CAMP05 International Workshop on Computer Architecture for Machine Perception*. Terrasini–Palermo, July 4–6, pp. 321–326

A Semantic Framework for Enterprise Knowledge Management

M. Ruffolo

Abstract This paper presents a semantic enterprise model-ling approach that allows the representation of enterprise knowledge by means of ontologies. The approach supports the analysis and design of KMSs and KM strategies by enabling the representation of Semantic Enterprise Models (SEM). A SEM expresses the enterprise knowledge by means of two interconnected ontologies: The Top Level Ontology (TLO) and the Core Enterprise Entities Ontology (CEKEO). The TLO contains concepts related to the different topics characterizing business activities, the CEEO describes organizational, business, technical, knowledge resources. The paper presents also a semantic annotation approach that allows to annotate Core Enterprise Entities (CEE) with respect to one or more TLO concepts. This way SEMs allow both to formally represent enterprise knowledge and to semi-automatically annotate CEE whit respect to relevant enterprise concepts. SEM can be used as kernel of a new family of Enterprise Knowledge Management Systems providing capabilities for semantically manage all the relevant enterprise knowledge resources.

Introduction

During the last years technological innovations, social and economic transformations have deeply changed the global market and the enterprises structure all over the world. Knowledge has become one of the most important economic resources with respect to the competitive advantage acquisition turning the traditional enterprises into Knowledge Intensive Organizations (KIO) [1]. KIOs are characterized by complex managerial, operational and decisional processes [2] involving a number of different forms and kinds of knowledge following a "Knowledge Life-Cycle".

In this scenario Knowledge Management (KM) can really increase the efficiency and effectiveness of the enterprise business processes, contribute into the creation

CNR-ICAR, Pisa, Italy, ruffolo@icar.cnr.it

of value, contribute into growth of intellectual capital and all the intangible assets within enterprises. To obtain these results a new family of efficient KM Systems (KMS) and coherent KM strategies are needed to support the enterprises in managing knowledge created, stored, distributed and applied during business process execution.

The problem to extract, acquire, store, classify, distribute and share automatically enterprise knowledge is widely recognized as a main issue in the field of knowledge management and has been extensively studied [3, 4]. Current KMSs make actionable only a small part of all the available enterprise knowledge because they suffer the following important limitations: (a) they are able to manage information rather than knowledge because to the lack of semantic support. Existing system do not provide powerful and effective knowledge representation mechanisms enabling to exploit the semantic of information; (b) they are able to process only a small portion of the whole available information because they provide rich and powerful representation formalisms as well as manipulation language and techniques only for structured information, whereas unstructured information are currently managed using mainly information retrieval approaches. So available information tend to be practically useless because of their vastness combined with the lack of manipulation techniques.

This paper describes a semantic enterprise modelling approach that allows the representation of enterprise knowledge by means of ontologies. The approach supports the analysis and design of KMSs and KM strategies by enabling: (a) the representation of Semantic Enterprise Models (SEM). A SEM expresses the enterprise knowledge by means of two interconnected ontologies. The Top Level Ontology (TLO) and Core Enterprise Entities Ontology (CEEO). The TLO contains concepts related to the different topics characterizing business activities and aims. The CEEO, describes business, organizational knowledge resources like: Human Resources: in terms of the profile of single persons and organizational groups (i.e., Groups, Community of Practices, Project Teams), for each person, personal data, skills, organizational areas and groups memberships, duties, access rights, participation to business processes activities and concepts of interest are represented; Knowledge Objects (KO): (i.e., textual documents of different for-mat) in term of their traditional (e.g, data of creation, document type) and semantic metadata (e.g., main concepts contained in the document, relevant referred entities); Immaterial Resources: in terms of tools by which knowledge objects are created, acquired, stored and retrieved during the execution of normal activities, brands, patents; Business Processes: in terms of sub-processes, activities, transitions, transition states and conditions, transition patterns, process instances and concepts characterizing the specific activities and process instances; (b) a semantic annotation approach. The annotated-to relationship defined in the SEM, allows to semantically annotate KOs with respect to one or more TLO concepts. This relationship follows the principle of superimposed information, i.e., data or metadata "placed over" existing information sources [5]. Annotations allow to provide un-structured information with explicit semantic descriptors (semantic metadata), represented by ontology concepts, that can be exploited, for example, to perform se-mantic based search. The creation of an annotation is supposed to reflect the content of a KO and it establishes the foundation for its

retrieval. This way KOs can be retrieved by specifying ontology concepts instead of keywords.

SEMs allows both to formally represent enterprise knowledge and to semi-automatically annotate Core Enterprise Entities (CEE) whit respect to relevant enterprise concepts. So it make possible the development of Enterprise KMS providing capabilities for search and retrieval of Knowledge Objects and all the relevant organizational entities.

Semantic Enterprise Modelling

In the 1990s many enterprise models aimed to give a formal representation of organizational structures in term of: processes, activities, resources, people, behaviours, goals, and constraints of enterprises and/or government institutions has been proposed in literature [6]. All these models consist of an ontology based on a vocabulary along with some specification of the meaning or semantics of the terminology within the vocabulary. For example, the Toronto Virtual Enterprise Ontology (TOVE) [7] is an ontology providing a shared terminology for the enterprise that defines the meaning (semantics) of each term in a precise and an unambiguous as possible manner using first-order logic; IDEF Ontologies [8] intended to provide a rigorous foundation for the reuse and integration of enterprise models; CIMOSA [9] aimed at provide an appropriate integration of enterprise operations by means of efficient information exchange within the enterprise with the help of information technology. All these ontologies attempt to describe in detail the whole organizational knowledge and structure. The resulting models are less flexible and not easily applicable in the very dynamic contest of a real enterprise.

The semantic enterprise modelling approach takes into account that the representation of SEMs must be a cooperative, flexible and agile process that must allows to capture the enterprise knowledge as combination of the knowledge owned by enterprise workers and stored into enterprise system. In fact, many different kinds of knowledge, contained in several sources (humans and systems), are wide spread within enterprises under different forms. The classical distinction and generally accepted classification, due to Polanyi [10] and extended by Nonaka and Takeuchi [11] identifies: “tacit and implicit knowledge”, that is the knowledge resulting from personal learning processes, present within each organization in terms of its members’ personal knowing; “explicit knowledge”, generally shared and publicly accessible within the enterprise. In particular, enterprise explicit knowledge regarding business processes and all the organizational activities is generally managed using a variety of heterogeneous information storing and processing infrastructures (e.g. databases, web services, legacy applications, document repositories and digital libraries, web sites, emails). Moreover explicit knowledge can be classified, on the basis of the internal representation format adopted by the specific information management system, in the following forms: “structured” (e.g., database), “semi-structured” (e.g., XML documents, legacy systems, web sites) and “unstructured” (e.g. textual documents, emails, etc.).

SEMs, aimed at representing and managing organizational knowledge, It can be defined as follow.

Definition 1 (SEM). A SEM is a 8-tuple of the form

$$\text{SEM} = <\text{TLOC,CEEOC,CEEOA,TLOR, CEEOR,R,I,RM}>$$

where:

- TLOC is a set of concepts that describe knowledge domains which the organization is interested in. C is typically initially defined by domain experts and enriched by enterprise knowledge workers.
- CEEOC is a set of concepts that describe Core Enterprise Entities.
- CEEOA is a set of CEEOC concepts properties (attributes).
- TLOR:TLOC → TLOC is a set of relations among TLOC concepts (e.g., represents, same-as, different-from, contains, associates, part-of, isa, related-to).
- CEEOR:CEEOC → CEEOC is a set of relations among CEEOC concepts (e.g., specifies, has-role, belongs-to-group, depends-from, has-skill).
- R:TLOC → CEEOC is a set of relations of annotation (e.g., annotated-to).
- I is a set of instances of CEEOC concepts.
- RM is a set of reasoning modules that can be used to infer knowledge from concepts, relationships and instances contained in the SEM.

A SEM can be split in two parts: (a) a Top Level Ontology (TLO), TLO = <TLOC,TLOR> and (b) an Core Enterprise Entities Ontology (CEEO), CEEO=<CEEOC,CEEOA,CEEOR,I>. The TLO provides a basic knowledge background on knowledge domains which the organization is interested in. The TLO can be viewed as a semantic network similar to a thesaurus. For instance, the TLO for an health care organization will contain concepts and relationships re-lated to diseases, clinical practices, drugs, surgery, etc. The CEEO provides a definition of the organizational structure in term of CEEs and relationships among them. Figure 1 shows the structure of the SEM. TLO concepts are depicted as orange ovals while CEEOC concepts as grey ovals. For lack of space attributes of CEEs are not represented. However, each CEE has its own definition also in terms of attributes. For instance, the CEE Knowledge Object that describes different types of unstructured textual documents, will contain attributes such as name, size, author, and so forth. The root concepts of the TLO and CEEO are respectively the class Thing and the class Entity. Relationships contained in TLOR, CEEOR and R (see Definition 1) have as super-relationships respectively: represents, specifies and annotated-to. The represents relationship and its sub-relationships are used to describe associations among TLOC concepts. For instance the same-as relationship is defined between two concepts C and C0 which are considered semantically equivalent. The specifies relationship and its sub-relationships, are used to link each other CEEs. For instance the has-role relationship is used to associate a human resource to its role within the organization (see Fig. 1). The annotated-to relationship and its sub-relationships allow to semantically annotate CEEs (e.g., Knowledge Objects) with respect to TLO concepts, by following the principle of superimposed information, i.e., data or metadata “placed over” existing information sources [6]. This relationship allows

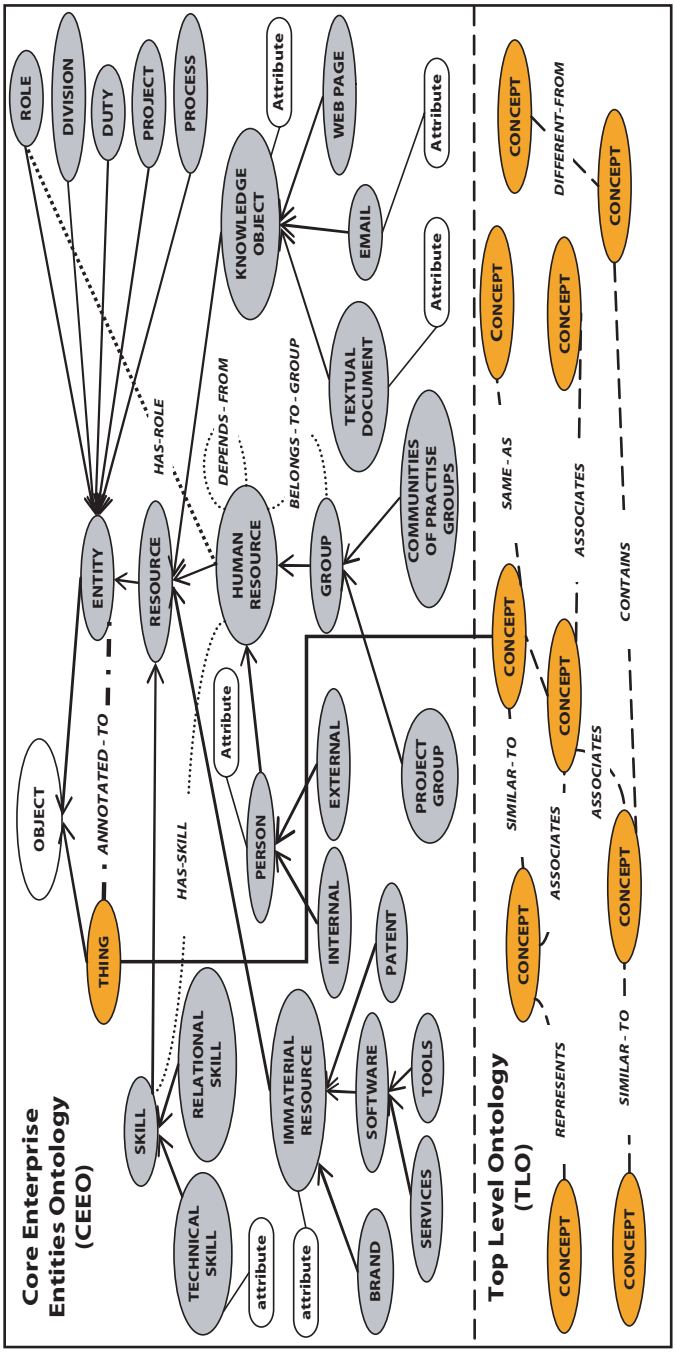


Fig. 1 The Semantic Enterprise Model. For the CEEO the taxonomical structure and some of the relationships existing among OEs are represented. The depicted TLO is a generic network of concepts

to provide unstructured information with semantic descriptors, represented by ontology concepts, that are exploited to perform semantic based search. The set of relationships included in the SEM can be customized according to organizational needs by adding new types of relationships.

Notice, that the SEM can evolve over the time for facing organizational requirements (e.g., when new EEs or new concepts of the knowledge domain are identified).

In order to make flexible and agile the representation of SEM the approach allows Enterprise Knowledge Workers (EKW) to extend the SEM by creating one or more Personal SEM (P-SEM). A P-SEM is the specialization of one or more TLO concepts and is used to deepen a particular aspect of the knowledge domain the EKW is interested in.

Definition 2 (P-SEM). A P-SEM is a 8-tuple of the form

$$\text{P-SEM} = <\text{SEM,TLOC',CEEOC',CEEOA', TLOR',CEEOR',R',RM'}>$$

where:

- SEM is the original SEM as described in Definition 1, originally provided by the enterprise to the EKW.
- TLOC' is the set of new TLO concepts added by the EKW.
- CEEOC' is the set of new CEEO concepts added by the EKW.
- CEEOA' is the set of new properties (attributes) of CEEOC' added by the EKW.
- TLOR' is the set of relationships among TLO concepts added by the EKW.
- CEEOR' the set of relationships among CEEO concepts added by the EKW.
- R' is the set of relationships between TLO and CEEO concepts added by the EKW.
- RM' is the set of reasoning modules added by the EKW.

A P-SEM operates at individual level as semantic support for personal knowledge management of EKWs that use the SEM, but need to extend it for their specific goals in organizational activities. The SEM can be used to annotate Knowledge Objects (e.g., textual documents, emails) with respect to personal concepts that describe their topics.

SEMs (and in particular the TLOs), represented by the OntoDLP ontology representation language [12], are initially defined by domain experts or obtained by importing already existing ontologies, then it can be enriched by merging concepts contained into available personal P-SEMs by using ontology merging approaches [12].

As well known the vast majority of information stored in digital information sources is in semi-structured and unstructured form, while the remaining part is in structured form. So the possibility of SEMs to represent KO and the provided annotation capabilities allow to semantically deal with the unstructured information management problem. The creation of an annotation is supposed to reflect the content of a Knowledge Object (KO) and establish the foundation for its retrieval when requested by an EKW. This way unstructured information can be semantically enriched, and its retrieving can be performed by specifying ontology concepts instead of keywords. The annotation process can be manual or automatic. Manual annotation is completely delegated to the user. However, it is expected that the annotation

process can be maximally automated to decrease the burden of the EKW. For this purpose, a method based on concepts recognition can be adopted. To decrease the burden a SEM provides a semi-automatic annotation mechanism which works on the base of the HiLeX system [13] that allows a se-mantic-aware approach to information annotation and extraction. The HiLeX sys-tem permits to recognize, extract, manage and store (in structured and/or unstructured format), automatically relevant information according to their semantics. Information to handle can be contained in unstructured sources holding documents having the more used internal formats (HTML, TXT, DOC, PDF, PPT, XLS, XML, etc).

Semantic Enterprise Knowledge Management Systems

SEMs enable to satisfy the following requirements for a KMS: (a) knowledge representation capabilities, provided by means of ontology languages, able to allow the specification of the different organizational knowledge forms and kinds and to carry out an abstract representation of enterprises entity supporting interoperability among different systems and organizational areas; (b) semantic unstructured information management capabilities, that can be provided by semantic information extraction approaches. Thanks to these capabilities the semantic annotation of unstructured document (KO) by means of semantic metadata is possible. This feature allows to exploit along with traditional keyword based-search a semantic-based search and retrieval approach that exploits concepts represented into the SEM.

Conclusions

This paper presented a semantic enterprise modelling approach that allows the representation of enterprise knowledge by means of ontologies. The approach sup-ports the analysis and design of KMSs and KM strategies by enabling: (a) the representation of Semantic Enterprise Models. A Semantic Enterprise Models ex-presses the enterprise knowledge by means of two interconnected ontologies. The Top Level Ontology and Core Enterprise Entities Ontology. By exploiting Semantic Enterprise Models a novel family of Semantic Enterprise Knowledge Management Systems that provide semantic capabilities for managing enterprise knowledge and entities and interoperate with already existing enterprise information management systems can be obtained.

References

1. Alvesson, M. (1993). Organizations as Rhetoric: Knowledge Intensive Firms and the Struggle with Ambiguity. *Journal of Management Studies*, 30:997–1015
2. Davenport, T. & Prusak, L. (1998). *Working Knowledge. How Organization Manage What they Know*. Boston, Harvard Business School Press

3. Tiwana, A. (1999). *Knowledge Management Toolkit, The: Practical Techniques for Building a Knowledge Management System*, Englewood Cliffs, Prentice Hall
4. Tyndale, P. (2002). A Taxonomy of Knowledge Management Software Tools: Origins and Applications. *Evaluation and Program Planning*, 25:183–190
5. Maier, D. & Delcambre, M. L. (1999). Superimposed Information for the Internet. Proceedings of WebDB, Philadelphia, Pennsylvania, USA, pp. 1–9
6. Fox, M.S. & Gruninger, M. (1998). Enterprise Modelling, *AI Magazine, AAAI Press*, Fall, pp. 109–121
7. Fox, M.S. (1992). The TOVE Project: Towards a Common-sense Model of the Enterprise, Toronto, Enterprise Integration Laboratory Technical Report
8. Fillion, E., Menzel, C., Blinn, T., & Mayer, R. (1995). An Ontology-Based Environment for Enterprise Model Integration. Paper presented at the IJCAI Workshop on Basic Ontological Issues in Knowledge Sharing, 19–20 August, Montreal, Quebec, Canada
9. Heuluy, B. & Vernadat, F.B. (1997). The CIMOSA Enterprise Ontology. Proceedings of the IFAC Workshop-MIM'97, 3–5 February, Vienna
10. Polanyi, M. (1966). *The Tacit Dimension*. London, UK, Routledge & Kegan Paul
11. Nonaka, I. & Takeuchi, H. (1995). *The Knowledge-Creating Company: How Japanese Companies Create the Dynamics of Innovation*. New York, USA, Oxford University Press
12. Ehrig M., de Bruijn J., Manov D., & Martín-Recuerda F. (2004). State-of-the-art Survey on Ontology Merging and Aligning V1 SEKT Deliverable 4.2.1, Innsbruck, DERI
13. Ruffolo, M. & Manna, M. (2006). A Logic-Based Approach to Semantic Information Extraction. Proceedings of the 8th International Conference on Enterprise Information Systems (ICEIS'06), Paphos, Cyprus

Part VIII
E-Services in Public and Private Sectors

M. Sorrentino[1] **and V. Morabito**[2]

Organizations and individuals are becoming increasingly reliant on computers and on global networks, while the type and number of e-services available on the internet are growing daily. E-service is defined as the provision of a service via electronic networks, such as internet, and wireless networks as well as electronic environments, and is a promising reference model for businesses and public service organizations. In addition, e-services are only a specific kind of service, involving mainly computer science, and engineering discipline, whereas economics and organization science exploit the main contribution to the study of service quality and value. The integration of these different perspectives is a major challenge in the emerging field of service science as a new relevant topic in IS research. Indeed, an integrated framework for the study of services underscores the need for new business models in both the public and the private sector, as this would enhance the collaboration between service provider and customer in generating value from the service interaction. These latter need to further integrate the provision of e-services with the productivity issues and IT business value related to the Enterprise IS Integration or Enterprise Application Integration (EAI). Such a scenario requires new models based less on reducing costs through automation and increased efficiency and more on expanding the possibilities by enhancing the service and building better customer/citizen relationships. The Track encourages interplay with theory and empirical research and is open to contributions from any perspective. Topics include (but are not limited to): Building e-public services: e-collaboration and e-services; Organizational implications of e-services; E-services and offshore outsourcing; Composing e-services in cooperative multi-platform environments: security issues; E-services and ERP; E-services: theoretical issues; E-services and software application quality; User trust and e-services; Offshore outsourcing; Enterprise Application Integration.

[1]Università degli Studi di Milano Dipartimento di Scienze Economiche, Aziendali e Statistiche, Milano, Italy, maddalena.sorrentino@unimi.it
[2]Università Bocconi, Milano, Italy, vincenzo.morabito@uni-bocconi.it

Infomediation Value in the Procurement Process: An Exploratory Analysis

T. Bouron and F. Pigni

Abstract This paper proposes the definition of a generic infomediation-procurement process for the analysis of ICT added value at the business process level. The interest on this approach lays in one hand in the separation of the information treatment from the procurement process in order to extract its added value and describe it as an independent process, and in the other hand to offer a different perspective based on procurement to understand the impacts of infomediation services on existing business models.

Introduction

In today competitive environment, information and intangibles resources have become fundamentals in the value creation process. Information Technologies (IT) and by extension Information and Communication Technologies (ICT) can create value from intangible assets that deeply impact value chains, industries' structures, and enable the spawning of entirely new business models [1]. However, defining precisely *where* and *how* ICT develop or create customer value is still a difficult task. These questions, initially investigated by IT services companies (e.g., IBM, Accenture), becomes relevant for telecom operators as their ICT offerings (RFId, localization, IM, VoIP, etc.) are increasingly oriented toward customer centered services. In particular, with the aim of increasing service productivity by properly using the experience "from one instance of a custom service into a new instance" [2]. This paper explores how ICT creates value optimizing current business processes and by enabling new added value on-demand services through information processing. It then propose for the analysis the definition of a generic process, called hereafter procurement-infomediation process, that combines product and information management activities along the physical and virtual value chains [3].

France Télécom R&D Division, Sophia Antipolis, France, thierry.bouron@orange-ftgroup.com, fpigni@liuc.it

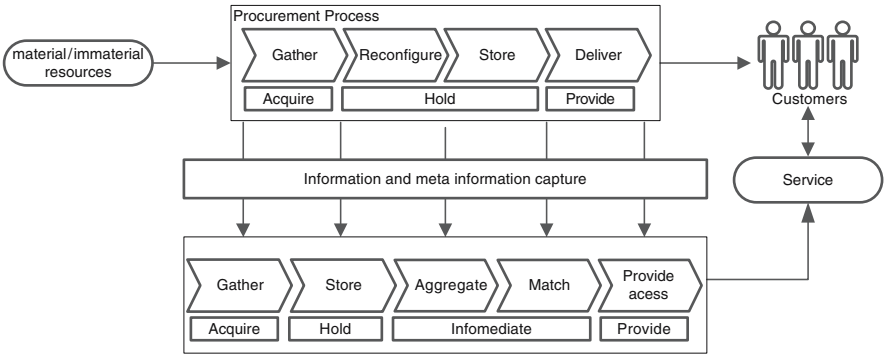


Fig. 1 The infomediation procurement process

Value Chain, Virtual Value Chain and Business Process[1]

The benefits of assessing IT business value at process level are widely recognized in literature (e.g., [4–6]) and Porter's value chain [7] is probably the most commonly adopted framework to represent them. Despite is usefulness in describing and analyzing manufacturing firms, Porter's approach seems to fail when applied in service and information intensive activities and inter-firm collaboration [8]. Rayport and Sviokla [3] partially solve this problem with their virtual value chain (VVC) model. VVC consists of a parallel sequence of activities performed to create value on the base of the information captured, at different stages of the physical value chain, by gathering, organizing, selecting, synthesizing, and distributing information (cf., Fig. 1). However, theses two models may not be sufficient in mixed product/service environments [8], or especially where the information or the services are the object of business processes that aim at acquiring, transforming and providing intangible resources to internal and external customers. We then propose to refer to a generic procurement-infomediation process that, as a service, combines product and information management activities and encompasses both the sourcing of information resources and the creation of value for the customer.

The Procurement Process

The procurement process consists of all the activities required to obtain "materials and services and managing their inflow into an organization toward the end user" [9]. Production and manufacturing literatures generally refer to the procurement activity in terms of the part of firm's logistics that deals with trading partners for materials management and the related acquisition process – differently specified. The reference to the phases of a transaction (information, negotiation, settlement

[1] The complete literature review is available upon request to the authors.

and after sales) is then widely adopted in these studies. Therefore, ICT effects on procurement are referred only to the buyer-seller relationship, and electronic markets. Little attention is devoted to the assessment of ICT opportunities in enacting the procurement process of information based resources inside and outside an organization. We propose then to consider procurement as the part in the value chain that, in an undifferentiated form, comprehends all the activities performed (1) to acquire physical (the "traditional" procurement process) and immaterial/informational resources from outside the organization, (2) to gather information regarding these resources (meta-information), (3) to hold them in "inventory," and (4) to deploy them to provide on-demand product/services to customers. The process is referable to a general business process model composed of three primary processes (acquire, hold, and provide) to obtain and manage the inflow of resources toward the customer. We further decompose the process analysis at the "virtual" level describing the infomediation process.

Information Processing in Infomediation

Infomediation value proposition is based on "information collection, aggregation, display and information processing" [10] in order to mediate – and thus facilitate – buyer/seller transactions. We extend the focus of infomediation from the facilitation of the transaction, to the value proposition of a service encompassing the range of information and processing activities of infomediation with the sole aim of configuring new value-added services [10]. Furthermore, viewing infomediation as a business process instead of a business model redefines the role of buyers and sellers acting, the first as information provider, and the seconds as internal and external customers.

The infomediation-procurement process can then be considered a service shaped during the interaction between the service provider and a customer (internal or external) consisting in the acquisition of information, its elaboration and provisioning as a general service to deliver – in form of intangible/information good – value to the customers. Based on the traditional notion of business process [11, 12] and a recent work [4], we define the infomediation-procurement service process as *the series of information based activities that delivers value, in form of service, to the final customer who in turns triggers and terminates it* (cf., Fig. 1).

Cases of Infomediation-Procurement Process

In this paragraph, we adopt the infomediation procurement framework to study ICT value in four different business models: *sell as broker, hold inventory, provide information services, and provide fleet-management*. These studies are the result of the aggregation and abstraction of several case studies analyzed in the scope of a research project in collaboration with the Center for eBusiness at MIT.

Sell as Broker Activity

Sell as broker activity is a generalization of the process of intermediation. The study was performed to assess the value of mobile real estate management solutions, based on smart devices, on real estate agencies. It resulted that ICT impacts on the procurement process produced an improvement in the number of matching outcomes with an effective sale. Smart devices were used by the sales staffs to load customer data on night before sales calls (order history, pricing, etc.) and to transfer in the CRM system the data gathered during the call.

The use of smart devices enabled buyers to integrate the standard offers retrieved from the MLSs (Multiple Listing System) with on demand pictures and information eventually provided by agents during the visits to the properties. Similarly, agents could interact with buyers sending follow-ups information in real time. The possibility to share seller's offers on MLS or other shared repositories prompted the use of web portals to attract buyers and extend the reach to a larger range of potential buyers. Another important aspect of ICT use in this process, it that buyers could self operate part of the services. In particular, they could access to information on available offers and to remotely interact and inquire agents. New value added services, such as direct-link 30 s phone follow up, are provided to customers to support self service. Smart devices effectively enabled 24/7 agency responsiveness and the ability to rapidly iterate proposals until any agreement is reached.

Hold Inventory Activity

The hold inventory process is abstracted from case studies on RFId applications in the retail industry. The infomediation-procurement process involves, other than the procurement of the physical goods, all the activities performed to retrieve the information on ASN (Advanced Shipping Notice), orders, or product codes, and to match these data with the identification codes retrieved from products' scans.

It was noticed that the online availability of seller's product records allowed buyers to immediately check the shipments consistencies against the placed order, therefore reducing the need of manual controls. The automated optimized claims and returned goods management, and when properly interfaced with companies ERP systems, enabled the automatic authorization of payments. Value was then transferred from seller to buyer in form information flows that resulted in process automation, enabling the reach of higher productivity, and in form of value added service when it enabled to manage claims. RFId value from warehouses management was more heterogeneous, ranging from companies fully exploiting the technology to improve stocks keeping, localization and movement, to outbound or inbound logistics only applications. It was noticed that the effects, and the related benefits, deriving from RFId technologies adoption is depending on the global automation of the procurement process and the extent to which RFId is combined with others ICT and informative resources available inside a company. Moreover, the

infomediation-process presets an interesting interorganizational dimension. The availability of the information to the different partners in a collaborative environment – specifically the supply chain – greatly impacts the general efficiency of partners by reducing the notorious "bullwhip effect."

Provide Information Service Activity

This general process is built from cases studies in different industries of in-house help desks, and outsourced call centers – both off and home shored. The infomediation-procurement process consists in the provision to operators of all the integrated information resources needed to answer customers' requests. The peculiarity of this process is that it has to handle and provide access to multiple resources to the mediating activity performed by the operator whom, in this case, acts as a human infomediator. As previously discussed, ICT impacts call center business model at all stages. It effectively optimized the dynamic allocation of the call handling staff, thanks to the greater routing capability of IP systems. This translated in an efficient response to customers' needs by easily switching and matching a pooled operator on the base of its specific competences. Dynamic IP routing enabled the new call centers business models based on operators' home shoring and off shoring. Through home shoring call centers can maintain service quality even in the event of surges in customers' calls and leverage specific expertise nationwide. Similarly, off shoring could greatly impact service productivity, employing operators in countries with lower operational costs. However, some call centers reported issues in managing the quality of off shored operators: despite an increase in productivity from lower costs some of them suffered of lower customer satisfaction; others reported that off shore services presented 25% lower costs, but home shored ones were 25% more productive. Referring to the cited analogy with physical stocks, call centers tried to achieve a "zero stocks" objective increasing their flexibility in processing the variable input – the customers – by dynamically routing the requests to available handlers. Moreover, ICT impacts on the infomediation process greatly improved operators' ability to answerer customers' requests providing advanced systems able to capture the knowledge gained from calls. In some cases, it was observed a shift from informal, face-to-face interactions among operators toward technology mediated ones (chat room and IM). This effectively contributed to the formation of collaborative networks among operators geographically dispersed.

Fleet Management Activity

The fleet management activity is built mainly from the case study of a taxi company in Barcelona and represents an example of fleet management systems. Computer Aided Dispatch (CAD) systems became sadly famous after the failure of the London

Ambulance Service Computer-Aided Despatch (LASCAD) system [13], but new incarnations are finally providing value for adopting companies [14]. A CAD system is used to support the dispatch of vehicles to a destination, upon a call is received by the network, an activity that traditionally involved a substantial part of manual work. ICT produced impacts on all the phases of taxi management; starting from incoming calls management. Calls can be received through different media, like the phone, the fax and the Internet. The development of mobile services opened up new opportunities of interaction with customers that could require a proper integration of supporting applications in the CAD system. Enhanced taxi pooling allowed the company to match the pickup points with the effective position of each taxi in service and to issue to the customer both taxi number and estimated time of arrival, after the booking was confirmed. All taxis were equipped with terminals integrating wireless communication devices and GPS navigators that enabled bidirectional information exchange with the central CAD systems. Taxi drivers were able to signal their availability to enter service and to accept calls by simply pressing a confirmation button on the terminal displaying information on the pickup and a route to the location. In this way the taxi company has a real time control of the entire fleet and can provide additional services to both their main customers; the taxi drivers themselves and the passengers. Passengers not only receive confirmation of the booking or the precise evaluation of pickup time, but the assurance of lowest possible service time. Similarly, drivers reduce their cognitive efforts as they start to share information on their positioning for a prompt dispatch of available calls by just pressing a button and entering service, instead of relying on radio communications. The integration of other informational resources can then used to generate further value for both customers, granting the access to drivers' and vehicle history records, to profiles and financial figures – such as generated revenues – or to CRM and lost and found applications [14].

Discussion and Conclusions

The proposed framework was used to analyze separately the procurement activities and the related information treatment thus distinguishing, in terms of value creation, between ICT productivity impacts on business process, and the service component. Despite the exploratory nature of this study, we demonstrated that the use of ICT in the product/service procurement process generates new valuable information resources that can be treated and integrated with others to increase the value of the service for both internal and external customers. Despite the context specificity of business value metrics [5] both the concept of productivity and quality provided useful to frame two broad categories of business value [5, 11]: the automational value, generated from process automation, and the informational value, originating from ICT capabilities "to collect, store, process, and disseminate information" [5]. The separation of the procurement process from the infomediation allowed the identification of both process and activities where value is created, and the different ways

it is generated [3]. The assessment of the service component of the value generating process additionally provides a value assessment the additional customer dimension detailing the transformational value of ICT. In particular, service value appears to stem from the higher "transparency" of businesses: customers are provided with the ability to access valuable firms' information and services resulting from the aggregation of IS and IOS resources. This analysis suggests that the service value emerging from the infomediation is the result of the different characterization of the information processing activities and the objectives pursued. This conclusion could be further investigated providing a general reference to study the value of information based services.

References

1. Porter, M.E. and Millar, V.E. (1985). How information gives you competitive advantage. *Harvard Business Review*, 64(4), 149–160
2. Chesbrough, H. and Spohrer, J. (2006). A Research Manifesto for Services Science. *Communications of the ACM*, 49(7), 35–40
3. Rayport, J.F. and Sviokla, J.J. (1996). Exploiting the virtual value chain. *The McKinsey Quarterly*, 1, 121–136
4. Davamanirajan, P., Kauffman, R.J., Kriebel, C.H., and Mukhopadhyay, T. (2006). System design, process performance, and economic outcomes in international banking. *Journal of Management Information Systems*, 23(2), 65–90
5. Mooney, J.G., Gurbaxani, V., and Kraemer, K.L. (1996). A process oriented framework for assessing the business value of information technology. *The Data Base for Advances in Information Systems*, 27(2), 68–81
6. Tallon, P.P., Kraemer, K.L., and Gurbaxani, V. (2000). Executive's perceptions of the business value of information technology: A process-oriented approach. *Journal of Management Information Systems*, 16(4), 145–173
7. Porter, M.E. (1985). *Competitive Advantage: Creating and Sustaining superior Performance*. New York: Free Press
8. Amit, R. and Zott, C. (2001). Value creation in E-business. *Strategic Management Journal*, 22(6–7), 493–520
9. Gebauer, J., Beam, C., and Segev, A. (1998). Impact of the Internet on procurement. *Acquisition Review Quarterly*, 141, 67–84
10. Bhargava, H.K. and Choudhary, V. (2004). Economics of an information intermediary with aggregation benefits. *Information Systems Research*, 15(1), 22–36
11. Davenport, T.H. (1993). *Process Innovation: Reengineering Work Through Information Technology*. Boston, MA: Harvard Business School Press
12. Hammer, M. (1990). Reengineering work: Don't automate, obliterate. *Harvard Business Review*, 68(4), 104–112
13. Beynon-Davies, P. (1995). Information systems 'Failure': The case of the London ambulance service's computer aided despatch system. European *Journal of Information Systems*, 41, 71–84
14. Teo, T.S.H., Srivastava, S.C., and HO, C.K. (2006). The trident model for customer-centric enterprise systems at comfort transportation, Singapore. *MIS Quarterly Executive*, 5(3), 109–124

Business Models and E-Services: An Ontological Approach in a Cross-Border Environment

A. M. Braccini and P. Spagnoletti

Abstract In business practice and in scientific research business models seem to have caught much attention as this phenomenon has been investigated by many disciplines, with different objectives and point of views. Researchers' general opinion on business models is based on value and information technology in an organization or a set of linked ones. Anyhow, a common agreed theoretical background and even a shared definition of business models are still missing. In this paper we will analyse the relevant literature on business models to increase understanding on this topic and identify future research directions. By discussing results of this analysis we will introduce an action research study on business models in cross-border e-services environment.

Introduction

In business practice and in scientific research business models seem to have caught much attention. It is not so easy to estimate an exact measure of this phenomenon. Searches in Google and in databases of scholarly peer reviewed journal have been used in literature to estimate this size [1, 2]. The same searches repeated now show the attention is high. In spite of this great interest there seems to be not so much shared understanding of the BM concept as a theory and even a common definition are missing.

BMs have been studied with diverse research interests and objectives in mind facilitating overlaps and conflicts [3]. Authors usually show the tendency to start from scratch instead of supporting established researches: this is partially due to the large amount of disciplines and point of views used to study and describe this phenomenon [4]. The poor understanding of such a broad phenomenon is cited by Porter as a cause of the wrong approach to competition by dot-coms [5].

Università LUISS – Guido Carli, CeRSI – Centro di Ricerca sui Sistemi Informativi, Roma, Italy, abraccini@luiss.it, pspagnoletti@luiss.it

Attempts to summarize all the contribution given in this research field produced frameworks, categories, taxonomies and ontologies of BMs [1, 3, 4, 6, 7].

Researcher's general opinion on BMs state these concern value and information technology in a single, or a group of linked entities.

Adopting an interdisciplinary point of view we analyse and explore this phenomenon by reviewing the relevant literature in the field. The aim of this paper is to increase the understanding on BM research in order to identify possible future research directions which could provide a relevant contribution in the Information System area. Of course several studies agree on the role of BMs as communication tools for knowledge sharing among stakeholders, our objective is to understand to what extent this concept can be helpful in the design process of an information system. This could be for instance the case of complex business scenarios where e-services are in place among multiple partners in a cross border environment.

The structure of the paper is as follows: Sect. Research Methodology, shows the research methodology used to select and analyse the relevant literature, Sect. Literature Review, includes the main results of this review, Sect. Discussion, discuss the results emerging from the literature review and Sect. Conclusion and Future Research contains our conclusion and our future research project presentation.

Research Methodology

BM research field is vast and occupied by many disciplines and areas of interest. To trace the most prominent contribution we used the Business Source Premiere database of scholarly reviewed journal.

We searched using the terms "Business Model(s)" in title and keywords of papers published in peer reviewed journal from 1990 till now. The search returned two sets of 210 (title) and 108 (keywords) papers, with a certain amount of overlap. To avoid redundancy these were joined: the final contained 261 papers. Given the objectives of our research we were interested only in papers dealing mainly with BMs which we define as research on BM. We read through the abstracts to reject every contribution not directly linked to our research interest, reducing the original sample to 79. We took only the most relevant and included some out of this sample but remarkable for us, the total number of selected papers was 42.

We classified each paper in a thematic area given the orientation of the journal where it was published and traced the given definition of BMs and the position of the author(s) in the research field by distinguish between integrationist and isolationist approaches [8].

Papers grouped in thematic areas were then analysed using the Burrell and Morgan's framework, widely used in the Information Systems literature as a conceptual map to trace the intellectual origins of research contributions when different paradigms are involved [9]. Discussions about the validity and legitimacy of this framework are out of the scope of this paper and can be found in the literature [10]. We came out with the decision to adopt this conceptual framework as we believe it

Table 1 Literature review results

Area	Num	Isolationist	Integrationist	Macro	Micro	None
E-Commerce	7	1	6	4	1	2
Management	8	7	1	2	3	3
Business	5	1	4	3	1	1
Computer Science	4	4	–	–	1	3
Finance	3	3	–	1	–	2
Organisation	3	2	1	1	1	1
Information Systems	3	1	2	1	1	1
Strategy	3	2	1	1	2	–
Economics	2	2	–	2	–	–
Technology	2	2	–	2	–	–
Other	2	2	–	1	–	1
Total	42	27	15	18	10	14

can help to increase the understanding of BMs research trends in such a variety of disciplines and approaches.

Literature Review

Results of the literature review are shown in Table 1. The columns indicate: the thematic area (*Area*), the number of papers in it (*Num*), the position of the contribution in the research field (*Isolationist and Integrationist*) and the characteristic of the given BM definition (*Macro*: without components, *Micro*: with components, *None*: no definition at all).

First of all our literature review shows fields interested in BMs research are numerous. Again these confirm BMs research is a highly interdisciplinary field.

Looking at the total we can say isolationist approaches are predominant. Until now there seems not to be an unambiguous tendency in this research field. This consideration is also supported by the numbers for the definition of the term BM. A macro definition is the most common but a relevant portion of the selected papers do not give one at all. Further considerations could be formulated by examining each thematic area individually.

Along with Management, E-Commerce is the most frequent area in our sample. Papers classified here mainly consider the impact of ICTs on the traditional way of doing business. Contributions in the E-Commerce field are mainly integrationist as clearly state their position in the BMs research field but at the same time fail to refer to the same concept. They perceive the fragmented nature of research on BMs too. None of the papers classified in this area share the same definition and there is a wide abundance of macro definitions which are, by nature, less precise. Understanding of BMs often remains unspecific and implicit [11]. Four out of seven papers in this area refer directly to BMs [7, 12–14] and deal with new flows of value derived by the introduction of ICTs in business. The rest is more focused on the research on BMs [3, 6, 11].

Awareness of BM concept essence is less perceived in Management area. Apart from the only integrationist approach which gives a detailed definition and traces the evolution of the concept in the relevant literature [15], others do not describe the term or provide only a general macro definition. Absence of definition is common in E-commerce area too, but it belongs to contributions which review the relevant literature. In Management field, BM is often referred to as a synonymous of strategy [16–19].

The Business field is widely centred on the research on BMs. Excluding the only isolationist approach, the rest of the papers try to clarify different aspects of BMs research. In this field there are attempts to define relationships between strategy and BMs [20], to review past literature, to clarify the concept and to identify its components [4, 21]. Relevant is the critic against methodologies used to derive classifications and taxonomies of BMs [22].

Technology, Computer Science and Finance areas are the most representative candidates for isolationism in BMs research because usually the term is not defined and considered as given. Authors who define it use a macro definition based on a description of activities to be done to obtain value from a technology [23] or are even more general. Some of these papers refer BMs not to a single organization but to an industry sector [24, 25].

Similar considerations are still valid for the isolationist Economics field. Anyhow here a BM is more referred to an economic system [26].

Positioning Organization was quite an issue, given the small number of papers in the sample and the equal presence of micro and macro definitions as well as its total absence. In this area a BM is usually described using case studies or examples taken from empirical cases [27].

In the Information Systems field the need to have a foundation for the research on BMs is clear. In spite of the paucity of research contributions found in this area, there are attempts to define and clarify the relationship between BMs and strategy [2] and to have a more rigorous definition of the term with the development of a BM ontology [1].

Finally in the Strategy group, approaches are mainly isolationists in nature and all the papers here classified refer to different definitions and concepts of BM but are centred on the core of value creation and destruction [28].

Discussion

Given the number of disciplines involved and the totally different approaches adopted in cited works, in order to understand research trends on this topic we try to depict the conceptual basis and the underpinning philosophical assumptions. With this aim we adopt the Burrell and Morgan's framework as an intellectual map to analyse socio-philosophical concerns in selected contributions. Fig. 1 shows the results of the analysis. To increase readability, considering that some areas shared the same position, they have been grouped by creating the following

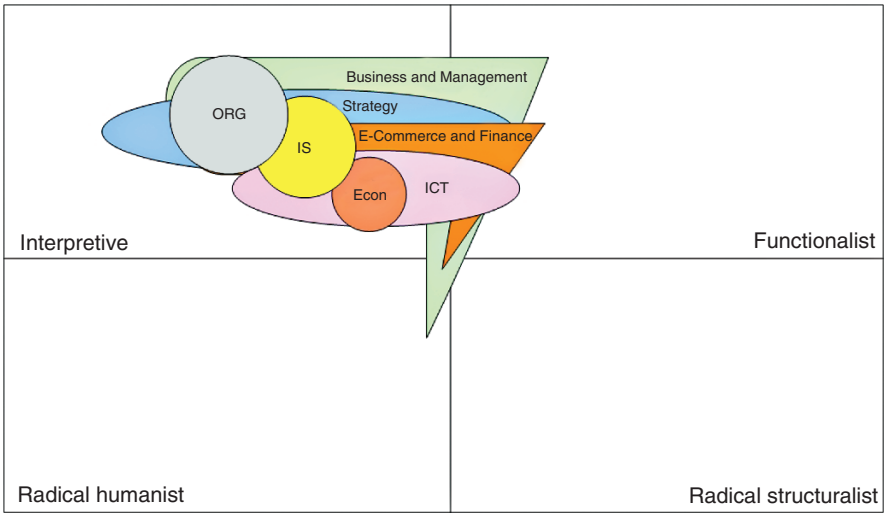


Fig. 1 Burrell and Morgan's framework

categories: E-commerce and Finance, Business and Management, ICT (formed by Computer Science and Technology). Shape and dimension of areas reflects the total amount of papers classified and their individual position.

The matrix clearly shows the prevalence of the interpretative paradigm in BMs research. Even though BMs have been studied by different disciplines using different perspectives, mostly all the contributions share a common ontological and epistemological approach. With these premises research on BMs seems to follow a common path. Interpretive paradigm predominance is common in new and not well understood field: this seems to fit perfectly with BMs research.

Anyhow following the consideration in the previous paragraph and looking at the diagram we argue that an objective understanding of BMs is still lacking. BMs research contributions led to different directions, due to different interpretations. We are far from a mutual understanding and a common theoretic background for BMs. Relevant literature shows the foundations of BM are rooted on technology and the way to gather value from it. Another import aspect is the relationship between strategy and BMs. We may sum up that finding how to gather value from a technology and defining steps to practically achieve this goal it is what BMs research is all about.

Interpretative paradigm predominance could be the reason for isolationism prevalence. If contributions on BMs are mainly based on interpretations it could be hard to find a common path because interpretations rely on subjective judgments and subjective judgments could easily diverge.

On the other end, objective perception of reality is scarce in this research field. Objective perception derives rational explanations from observation and measurement and defines general valid laws in order to predict or evaluate [29]. But if BMs are not clearly defined how can they be measured and described? The identification

of a set of candidate variables or phenomena to be measured or observed could be helpful in this context. Recent contributions adopt ontological approaches to summarize all the positions and derive a shareable concept of BMs [1, 7]. An effort to compare and integrate the two approaches could be useful to achieve the goal of a unique concept [30]. These ontologies could be used as a base for data gathering with the objective of defining new taxonomies and moving towards a theory of BMs [22]. Anyhow these are still defined over interpretive contributions. As an interpretive approach in part creates the reality studied through constructs used to view the world [29], research must be aware that variables to be measured could be outside the ontology. At this point it is worthwhile to mention a relevant critic in BMs research which, entering the radical humanist paradigm considers BMs as a dangerous and human created superstructure [5].

Conclusion and Further Research

In this paper we looked at BM research gaining a deep insight of this field of research. Our research suggests that ontology based approach applied to BMs could be a good starting point to make this field more objective.

We decide then to apply the Business Model Ontology to the LD-CAST European project which aims at increase cross-border cooperation among chambers of commerce using web services. The ontology has been proposed in order to help to define the BM for the proposed enabling platform. The use and adoption of the ontology will be studied and analysed in an action research project for one year. In our opinion this case seems to be particularly relevant as may be used to test the ontology as a communicative and design tool as well as a guide to identify variables to be measure to define how e-services adoption could be used to gather value provided the given scenario.

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References

1. Osterwalder, A., Pigneur, Y., and Tucci, C. L. (2005). Clarifying Business Models: origins, present, and future of the concept. *Communications of the Association for Information Systems*, 16: 1–25
2. Seddon, P. B., Lewis, G. P., Freeman, P., and Shanks, G. (2004). The case for viewing Business Models as abstractions of strategy. *Communications of the Association for Information Systems*, 13: 427–442
3. Pateli, A. G. and Giaglis, M. (2003). A framework for understanding and analysing eBMs. *16th Bled eCommerce Conference eTransformation*, Bled, Slovenia, June 9–11

4. Shafer, S. M., Smith, H. J., and Linder, J. C. (2005). The power of Business Models. *Business Horizons*, 48: 199–207
5. Porter, M. E. (2001). Strategy and the Internet. *Harvard Business Review*, 79: 63–78
6. Bienstock, C. C., Gillenson, M. L., and Sanders, T. C. (2002). The complete taxonomy of web Business Models. *Quarterly Journal of electronic commerce*, 3 (2): 173–182
7. Gordijn, J. and Tan, Y. H. (2005). A design methodology for modelling trustworthy value webs. *International Journal of electronic commerce*, 9 (3): 31–48
8. Canonico, P. and Martinez, M. (2006). Tradizioni di ricerca e teorie per l'analisi della relazione fra organizzazione e sistemi informative. *III Conference of the Italian charter of AIS*, Milan, October 26–27
9. Burrell, G. and Morgan, G. (1979). *Sociological Paradigms and Organizational Analysis*. Portsmouth, NH: Heinemann
10. Dhillon, G. and Backhouse, J. (2001). Current directions in IS security research: Toward socio-organisational perspectives. *Information Systems Journal*, 11 (2): 127–153
10. Dubosson-Torbay, M., Osterwalder, A., and Pigneur, Y. (2001). eBM design, classification and measurements. *Thunderbird International Business Review*, 44 (1): 5–23
11. Alt, R. and Zimmermann, H. D. (2001). Preface: Introduction to special section – Business Models. *Electronic Markets*, 11: 3–9
12. Chen, J. S. and Ching, R. K. H. (2002). A proposed framework for transitioning to an e-Business Model. *Quarterly Journal of electronic commerce*, 3 (4): 375–389
13. Macinnes, I., Moneta, J., Caraballo, L., and Sarni, D. (2002). Business Models for mobile content: The case of M-Games. *Electronic Markets*, 12 (4): 218–227
14. Vlachos, P., Vrechopoulos, A., and Pateli, A. (2006). Drawing emerging Business Models for the mobile music industry. *Electronic Markets*, 16 (2): 154–168
15. Schweizer, L. (2005). Concept and evolution of Business Models. *Journal of General Management*, 31 (2): 37–56.
16. Betz, F. (2002). Strategic Business Models. *Engineering Management Journal*, 14 (1): 21–24.
17. Karin, I. (2004). Improving flexibility in strategy formulation by adopting a new technology: Four internet-based Business Models. *Global Journal of Flexible Systems Management*, 5 (2): 43–50
18. Voelpel, S., Leibold, M., Tekie, E., and Von Krogh, G. (2005). Escaping the red queen effect in competitive strategy: Sense-testing Business Models. *European Management Journal*, 23 (1): 37–49
19. Wells, P. (2004). Creating sustainable Business Models: the case of the automotive industry. *IIMB Management Review*, December 2004: 15–24.
20. Mansfield, G. M. and Fourie, L. C. H. (2004). Strategy and Business Models – strange bedfellows? A case for convergence and its evolution into strategic architecture. *South African Journal of Business Management*, 35 (1): 35–44.
21. Osterwalder, A. (2004). The Business Model Ontology – A proposition in a design science approach. *PhD dissertation*, University of Lausanne (Switzerland)
22. Lambert, S. (2006). Do we need a "real" taxonomy of e-Business Models? *Flinders University – School of commerce research paper series*, 06–6 ISSN 1441–3906
23. Roger, A. (1998). E-Commerce security: An alternative Business Model. *Journal of Retailing Banking Services*, 20 (4): 45–50
24. Fisken, J. and Rutherford, J. (2002). Business Models and investment trends in the biotechnology industry in Europe. *Journal of Commercial Biotechnology*, 8 (3): 191–199
25. Nosella, A., Petroni, G., and Verbano, C. (2004). Characteristics of the Italian biotechnology industry and new Business Models: The initial results of an empirical study. *Technovation*, 5 (18): 841–855
26. Feng, H., Froud, J., Johal, S., Haslam, C., and Williams, K. (2001). A new business model? The capital market and the new economy. *Economy and Society*, 30 (4): 467–503
27. Chesbrough, H. and Rosenbloom, R. S. (2000). *The role of the Business Model in capturing value from innovation: Evidence from Xerox corporation's technology spinoff companies*. Cambridge: Harvard Business School

28. Boulton, R. E. S., Libert, B. D., and Samek, S. M. (2004), A Business Model for the new economy. *Journal of Business Strategy*, 34 (3, 4): 346–357
29. Orlikowski, W. J. and Baroudi, J. J. (1991). Studying information technology in organizations: research approaches and assumptions. *Information Systems Research*, 2 (1): 1–28
30. Gordijn, J., Osterwalder, A., and Pigneur, Y. (2005). Comparing Business Model ontologies for designing e-Business Models and value constellations. *18th Bled eConference eIntegration in Action*, Bled, Slovenia, June 6–8

Second Life: A Turning Point for Web 2.0 and E-Business?

M. R. Cagnina and M. Poian

Abstract This work analyses the issues that firms must challenge with Web 2.0 tools. In particular, we focus on the metaverse, and Second Life is our case study. We find this platform is able to mash–up web-based features with distinctive aspects of the metaverse. We propose a theoretical framework that explains how the enactment of an environment gives rise to processes of engagement and creation of communities of prosumers. These aspects are unexplored yet and may represent a future and fascinating challenge for Management and IS disciplines.

Introduction

In the last decade, the whole society has known a great deal of development. Important phenomena such as globalisation of markets and industries and the process of digitalisation of assets and information have produced relevant changes in our lives [1]. However, it is fairly plain the major challenges for firms are those arisen by the kombo IT spreading-Internet boom. Technological changes open new ways for business "giving rise to powerful new models of production based on community, collaboration and self-organization" [2].

But the "web revolution" resulting from the social networking isn't the only change. In the last year new models of web-based tools, like virtual worlds, have emerged, and they open new scenarios for the future [3].

In this article, we propose an analytical framework in order to allow us to understand how new web-based technologies impact e-business practices. In particular, we are going to focus on the case of Second Life (henceforward, SL), a virtual world developed and produced by the US firm Linden Labs (henceforward, LL) that increasingly interested real world companies.

Università di Udine, Dipartimento di Economia, Udine, Italy, cagnina@uniud.it, michele.poian@uniud.it

The Emerging Web 2.0: An Overview

There is a lot of confusion and roughness about what Web 2.0 exactly means and what the tools that permit to tap into the Web 2.0 logic are. The foundation for the concept is based on the evolution of the vision implicated in the seminal formulation of "social software," developed by Taylor and Licklider [4]. According to O'Reilly: "Web 2.0 is a set of economic, social and technology trends that collectively form the basis for the next generation of the Internet – a more mature, distinctive medium characterized by user participation, openness, and network effects" [5]. Simply put, Web 2.0 sets up the conditions for a new way of considering the web: exogenous conditions, which represent the technological structure[1] that define the boundaries of human interaction; endogenous conditions, which refer to the capability of users to manipulate the technological tools in order to being involved into processes of content creation [6]. A few authors tried to define a core of accepted characteristics that properly describe the Web 2.0 conceptualization. Among these features, the most important ones concern: reaching high levels of interconnection among different users; involving users in multi-directional interactive processes; promoting an open source philosophy; developing a pattern of endless improvement; promoting complementarities and voluntary engagement; enabling users in self-production processes of content and knowledge; sharing content and information in a dynamic and peer-to-peer way; changing the role of users, which pass from being passive consumers to proactive ones, what Toffler [7] named "prosumers."

All these actions and processes are enabled through the rising and increasing adoption of IT on-line applications, which assume in substance the form of new media, i.e. blogs, wikis, social networks (My Space), searching engines (Google), on-line games (Second Life). Clearly, the wind of change fostered by the shifting towards a web 2.0 paradigm impacts on the relation between firms and customers. One of the most important factors that firms are dealing with resides in the greater amount of exchanged information. Between firms and consumers start a virtuous cycle [8], in which bi-directional flows of bits create a new equilibrium between business and consumption, giving room to new opportunities to create new business models and to enable innovative value creation processes.

Metaverse[2]

Among the tools that describe the Web 2.0 paradigm, we will focus our attention on the so-called metaverse [9–11]. Also known as virtual worlds or digital

[1] The technological advancement is shaped by the accelerating and growth law curves [9], such as Moore and Metcalfe Laws [1].

[2] The term metaverse has been coined by Neil Stephenson in the sci-fi novel Snow Crash [9]. The author imagines a digital world in which people live an artificial life that becomes as important as real life.

environments[3], Smart and others [12] define the metaverse as a "complex concept. The metaverse is the convergence of (1) virtually enhanced physical reality and (2) physically persistent virtual space. It is a fusion of both, while allowing users to experience it as either." On the other side, the complexity of the metaverse it is also witnessed by the fact that it has been built on the base of a patchy rearrangement of characteristics that are taken from different media: therefore, a metaverse groups elements from social networks, traditional media, blogs, video on-demand and also and especially interactive digital entertainment software.

The metaverse has been recognized as being part of Web 2.0 applications [11]. In fact, it adheres to a certain degree to the aforementioned Web 2.0 principles, such as the endless involvement or the participative behaviour of users. But it is worth of note that metaverse goes far beyond the features of Web 2.0 tools. The unique aspects that characterize this virtual place create a richer environment and, as a consequence, a more complex and fulfilling experience [3] people can have access to. In particular, it is possible to highlight the following facets:

- The aggregation capability: the metaverse is an ideal platform for experimenting mash-ups and gather feedback and suggestions to improve them.
- It gives a 3-D digital representation of the environment.
- It permits to develop peculiar forms of interaction among player-to-computer, player-to-player and player-to-game [13].
- Finally, it permits to create a digitally constructed presentation of self, which is at the same time immediately recognizable by other users [3, 14].

The latter appears to be the most interesting but also difficult to manage characteristic of the metaverse. Indeed, the presentation of self through an avatar is mainly a social construct. Far from being a clone of the person, the avatar acquires a personality, an appearance shaped by the experiences and interactions lived in the metaverse. Therefore, different analytical levels of analysis become worth of consideration. Bittanti [14] identifies three dimensions, which are de-scribed in terms of First Life – the concrete, real world dimension, which refers to the social practices realized by the person; the Second Life – the acting of the avatar within the metaverse; and, finally, the agency – the process that results from the interaction between first and second life. For firms, it becomes important to coherently tag the right levels, as their efforts can target different levels and have different effects to each level. For instance, Hemp [15] and Holzwarth [16] affirm that avatars may be targets of dedicated marketing policies: on one hand, they can influence users' behaviour; on the other, avatars themselves can also be the beneficiaries of the marketing message.

[3] In his book, professor Castronova [3] pinpoints the terminological problem. Indeed, he adopt the expression synthetic worlds, because the concept of metaverse "does not reflect the rendered, role playing aesthetic" that characterizes synthetic worlds. However, since metaverse has taken wider acceptance, we will continue to maintain Stephenson's conceptualization.

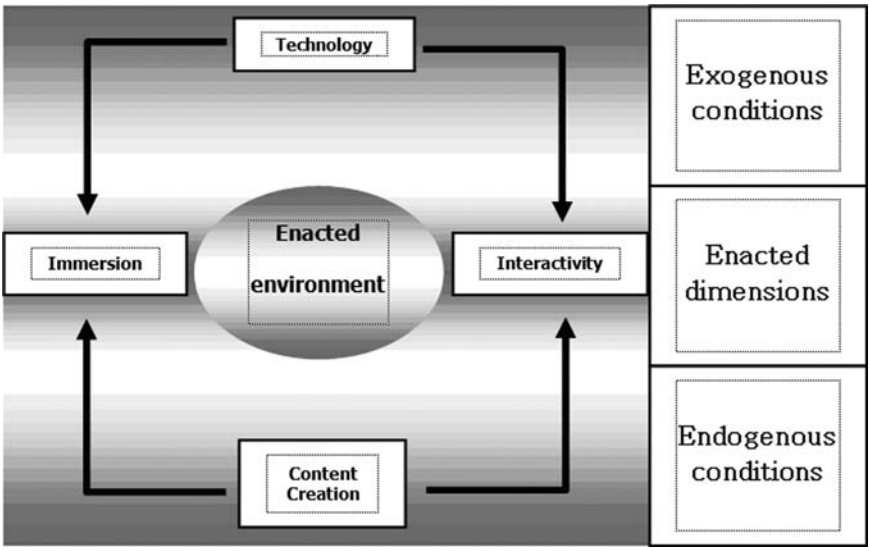


Fig. 1 A framework for Web 2.0 tools

An Analytical Framework for Web 2.0 Tools: Focus on the Metaverse

In this paragraph, we are going to present a theoretical hypothesis that may represent a preliminary toolbox to understand all the business possibilities concerning Web 2.0 platforms. Our proposal is defined by a specific framework, which summarizes the most important dimensions of these technological environments (Fig. 1).

On the vertical dimension, we identify technology – the set of structural conditions that defines the characteristics of digital interactions – and the content creation – the way users manipulate the technology in order to satisfy their needs. On the horizontal dimension, we proceed by hypothesizing the existence of two meaningful analytical dimensions, which are interactivity and immersion:

- *Interactivity* deals with all the processes that set up between users, hardware and software. Indeed, interaction can be defined as one of the most important and distinguishing technical characteristics of the aforementioned social media. In particular, the design and functionalities embedded in interfaces influences learning-by-doing processes and skills acquisition, which are the foundation for the phenomenon of User-Created Content [5]. Therefore, the process is both social and technological.
- *Immersion* refers both to a technological [10] and social [17] meaning too. The latter refers to the process of involvement and the motivation experienced by the users, whilst Klein [18] reports that "sensory immersion had a positive impact on telepresence and on brand attitude, self-reported product knowledge and on purchase intention."

As shown by the framework, the vertical conditions impact on the analytical dimensions we identified. Interactivity and immersion became, thus, the dimensions that allow users to enact the environment: this process of sense-making [19] makes the "virtual" something of "real." Users become aware of being part of a community, which they contribute to build and improve. In this sense, the "experience is the consequence of activity" [20]; in such web-based environments, the enactment can be obtained leveraging on immersion and interaction.

Case Study: Second Life

SL is a metaverse that relies on a unique combination of grid computing and streaming technology. It has been put on-line by LL starting from 2003, when the society released the definitive version of the program. SL takes a very different approach, recognizing residents' intellectual property rights to their creations, allowing them to generate real-world income and selling them as much digital real estate as they desire [21]. Moreover, LL implemented also an economic system, with an official currency – the Linden $ – that "residents" can use for their economic transactions. The currency is electronic, but not virtual, as it can be exchanged versus US $. As a user-created digital world, the ultimate success of SL is coupled to the innovation and creativity of its residents, not to ownership of their intellectual property.

We decided to focus on this metaverse at least for two reasons: first, several real world firms joined the platform, like as Mercedes-Benz, Coke or IBM[4]; and second, SL is a platform that massively relies on the interlacement among technology, content and interactivity [23]. A platform such as SL combines the advantages of the web-based tools with the unique features of the metaverse. The technological frame established by LL enables users to reach the highest levels of content creation. Indeed, the three-dimensional structures and items that form the digital environment can be created likely by every SL user, as the editing programs are part of the experience [21]. Therefore, within the platform, the boundaries between firms and customers blur, as everyone is at one time consumer and producer of content. SL residents can be all considered as "prosumers" that collectively enact the environment. On the other side, the enactment assured by the kombo immersion/interaction yield two main results: the development of a strong sense of membership lead prosumers to aggregate into a community – from communities of users to communities of prosumers; within an enacted environment, it is possible to reach potential consumers into new ways, because of the compelling and involving experience delivered by SL – from reaching to engaging users.

Firms that entered SL find a platform in which is possible to experiment new strategies and approaches to get in touch with a potential and peculiar community. When firms demonstrate to understand the features of the enacted environment and

[4] An updated list of the firms that joined the metaverse is "The Definitive Guide to Brands in Second Life," developed by Nic Mitham [22], founder of the KZero SL marketing society.

the activity of a community of prosumers, they were able to develop new business models and strategies [24]. Examples of successfully virtual business strategies in SL are:

- *Engagement*: The marketing campaign developed by the agency This Second Marketing LLC for the "Harry Potter and the Order of the Phoenix." This viral marketing campaign based its success on the recruitment of a team of avatars that acted as "buzz agents." These agents used the avatar to engage people in the metaverse, persuading them to see the movie on IMAX theatres. This campaign has been claimed to be the main impetus behind IMAX breaking all of its box-office records.
- *Community of prosumers*: The Virtual Thirst competition promoted by Coca-Cola Company. Because Coke is ubiquitous in our culture, marketers needed to experiment a marketing campaign different from traditional broadcast advertising. They aimed to a marketing efforts able to add value to the brand. In doing so, Coke called on the virtual community that resides online in SL to submit their most inventive ideas for the next generation of Coke machines. In substance, the company recognized that, as long as virtual drinks don't match with avatars needs, it was better to leverage on the creativity of the Second Life community, in order to engage people in designing what a "Coke side of the life" means.

On the other side, the exploitation of these elements is an everything but banal factor. Many firms, such as Adidas, American Apparel, Dell Computer and NBA, early joined the metaverse [24], but they obtained a poor return from their activity. The reason lied in their inability of understanding the complexities of SL; as a consequence, they adopted traditional strategies and business models, which revealed in being incoherent with the characteristics of the metaverse.

Conclusion

In this article, we argued about the possibility that a media such as SL have the potentiality to become the "Killer application" [1] of the Web 2.0. A platform that mashes the metaverse and Web 2.0 tools up and that has features, such as captive three-dimensional environment, establishment of large social relationships among participants, strong editing possibilities, involvement and membership, enables a concept of experience rather than fruition [25]. By the way, the possibility of engaging people and the sense of membership of prosumers allows us to affirm that we are entering into an era where the experience is persistent and not memorable [25]. Experiences mediated by media like SL are clearly leading us towards a more structured concept of experience, which is based on co-participation and co-production [3] and it enables new processes, yet unexplored, of creation of value.

References

1. Downes, L. & Mui, C. (1999). Killer App: Strategie Digitali per Conquistare i Mercati. Milano: ETAS
2. Tapscott, D. & Williams, A. (2007). Wikinomics: How Mass Collaboration Changes Everything. New York: Penguin Books
3. Castronova, E. (2006). Synthetic Worlds: The Business and Culture of Online Games. Chicago: University of Chicago Press
4. Licklider, J. & Taylor, R. (1968). The Computer as a Communication Device. Science and Technology, 76, 21–31
5. O'Reilly, T. & Musser, J. (2006). Web 2.0 Principles and Best Practices. Sebastopol, CA: O'Reilly Media.
6. OECD (2007). Participative Web: User-Created Content. OECD report. Http://www.oecd.org/dataoecd/57/14/38393115.pdf. Cited 25 September 2007
7. Toffler, A. (1980). The Third Wave. New York: William Morrow
8. Marcandalli, R. (2007). Web 2.0: Tecnologie e Prospettive della Nuova Internet. Http://www.zerounoweb.it/index.php?option=com_content&task=view&id=1658&id_tipologia=3. Cited 26 September 2007
9. Jaynes, C., Seales, W., Calvert, K., Fei, Z., & Griffioen, J. (2003). The Metaverse – A Networked Collection of Inexpensive, Self-Configuring, Immersive Environments. ACM International Conference Proceeding Series, 39, 115–124
10. Ondrejka, C. (2004). Escaping the Gilded Cage: User Created Content and Building the Metaverse. New York Law School Law Review, 49, 81–101
11. Stephenson, N. (1992). Snow Crash. New York: Bantam Books
12. Smart, E., Cascio, J., & Paffendorf, J. (2007). Metaverse Roadmap Overview. Http://www.metaverseroadmap.org. Cited 24 September 2007
13. Friedl, M. (2003). Online Game Interactivity Theory. Hingham: Charles River Media.
14. Bittanti, M. (2007). Prima, Seconda, Terza Vita. Presenza, Assenza e Agenza in Second Life. Http://www.videoludica.com/graphic/dynamic/news/pdf/246.pdf. Cited 27 September 2007
15. Hemp, P. (2006). Avatar-Based Marketing. Harvard Business Review, 84, 48–56
16. Holzwarth, M., Janiszewski, C., & Neumann, M. (2006). The Influence of Avatars on Online Consumer Shopping Behavior. Journal of Marketing, 70, 19–36
17. Cova, B. & Carù, A. (2006). A How to Facilitate Immersion in a Consumption Experience: Appropriation Operations and Service Elements. Journal of Consumer Behaviour, 15, 4–14
18. Klein, L. (2002). Creating Virtual Experiences in Computer-Mediated Environments. Review of Marketing Science Working Papers, 1(4), Working Paper 2
19. Weick, K. (1995). Sensemaking in Organizations. London: Sage publications
20. Weick, K. (1993). Organizzare. La Psicologia Sociale dei Processi Organizzativi. Torino: ISEDI
21. Ondrejka, C. (2004). Aviators, Moguls, Fashionistas and Barons: Economics and Ownership in Second Life. http://ssrn.com/abstract=614663. Cited 23 September 2007
22. Mitham, N. (2007). The Definitive Guide to Brands in Second Life. http://www.kzero.co.uk/blog/?p=790. Cited 28 September 2007
23. Book, B. (2005). Virtual World Business Brands: Entrepreneurship and Identity in Massively Multiplayer Online Gaming Environments. http://papers.ssrn.com/sol3/papers.cfm?abstract_id=736823. Cited 22 September 2007
24. Nissim, B. (2007). Virtual World Transition: What SL Business Model Works Best? http://www.marketingprofs.com. Cited 24 September 2007
25. Pine, J. & Gilmore, J. (2000). L'Economia delle Esperienze. Milano: ETAS

Development Methodologies for E-Services in Argentina

P. Fierro

Abstract The paper is a work in progress developed with the collaboration of the Laboratory of Computer Science of the Faculty of Engineering of the University of Buenos Aires. The main aim of this research is the analysis, from a qualitative and quantitative point of view, of the characteristics of the principal methodologies used for development e-services in the sector ICT in Argentina. The research methodology is based on a descriptive investigation based on questionnaires and focus group to the projects manager of the 272 software houses subscribed to the – Cámara de Empresas de Tecnologías de Información de Argentina, that includes the principal national and foreigners actors that operate in the ICT sector in Argentina. The first results of the search have made to emerge that under favorable context conditions the actors experiment innovative solutions. In the case in examination, the characteristics of the methodologies of development of architectures for e-services, the research is underlining the use of the c.d. Service Oriented Architectures (SOA) in comparison to systems formalized of methodologies of development [1, 2].

The ICT Sector in Argentina

The idea to deepen such thematic and to effect a survey within the sector ICT in Argentina was born in consideration of the specificities and the peculiarities of the Country, that has made to record the devaluation of the national currency (Argentinian pesos) in 2001. Actually, the exchange rate between US$ and Argentinian Peso is 3 to 1, while the exchange rate between Euro and Argentinian Peso is 4 to 1. Such conditions, additionally to a really low job costing, and in consideration of the good level of services offered by the educational public system have represented a good opportunity for the greatest computer services providers, that have moved above to Argentina some software houses for the development of new solutions.

Università di Salerno, Salerno, Italy, fierrop@unisa.it

Such context conditions have represented a fertile research ambit to deepen themes among the computer science and the organization theory.

The IT sector in Argentina was born in the '60 and it markedly develops itself according to an internal market strategy. During the first half of the '80 predominated the imported software use, and 300 firms operated. Of them, 200 realized software development, although not necessarily to commercialize it. While the base software and the utilities programs (operational systems for example), had predominantly foreign origin, the applications were mainly furnished by local software houses [3].

The Argentinian potentiality as supply center of services at international level it is also confirmed observing the investments realized by 2002 for the installation of call centers, contact centers, etc., which have produced new employment. It deals with an activity in which the job cost is decisive, and therefore it would be able suggest that in a scenery of progressive recovery of the dollar purchasing power of the local salaries, the attraction of Argentina for this type of investments should go decreasing. Nevertheless, the tendency observed confirms that exists potential to take advantage of the ability of the local manpower to furnish ICT to third services, and this allows to put to Argentina in that world map of countries with ability to compete with success in this sector. Others encouraging elements in the same sense rise from the decision of Motorola to invest to Cordova in a center destined to software development and the installation of a software factory in the local branch of IBM and SUN Microsystems [4].

From the Human Resources side, we observe a percentage of the population with educational credential superior in Argentina than in others countries like Ireland, Korea, Spain or Israel. Besides, in comparison to countries as India and China the Argentinian university system is free even if very competitive.

We are observing that training of high-level human resources is increasing to improve the formation of the human resources.

In synthesis, the principal sources of competitive advantage in Argentina are:

- Qualified human resources.
- Innovation and creative ability.
- Suitable telecommunications infrastructures.
- Costs and competitive prices.
- Partnership among government, academic sector and entrepreneurial sector.
- Strong recovery of the inside market and legal currency that stimulates the development of the sector.

The Research Project: Aims, Methodology and First Results

General objective of the research is to underline within coherent processes of planning and development of information systems (IS), the compatibility and, in some cases, the necessity to overlap methodologies of development of IS that base on different theoretical models. The theoretical approach we are following is the organizational one, since the overlap and the joined use of such methodologies it is

strongly correlated to the increase of the complexity of the inside context. The understanding and the translation into the IS of such complexity depends on the ability of the development team to activate continuous and mutable organizational experimentations that are concretized in not conservative change processes.

On the operational side, in fact, it's assisted in a first phase to the planning and the rational development of the IS (deliberate methodologies), in which the cause-effect relationships among the organizational variable are clear and defined. In a following phase, instead, the understanding of the organizational complexity imposes often "changes of rout" that are translated in the application of emergent methodologies, that frequently contribute to the best fit technology and structure [5].

Deliberate methodology represents in reality a plan, a direction, a guide, but it is also a model of coherence of behaviour in the time. The understanding of the complexity of the organizational reality in which the IS is implemented requires nevertheless an amplification of the action ray of such processes that results in emergent methodologies.

The survey focuses on the development of there e-services for two motives. In first place, it represents a new model of development of computer applications that allows not only to rationalize the construction and the management of the informative systems, but in the meantime it allows to realize solutions of cooperation between applications and organizations. For Service Oriented Computing we intend a model of computation founded on the service metaphor, understood as processing function easily accessible. In this context, the computer applications are considered as a whole interactive services that offer services to other applications rather than to end users. Processing is generally understood as distributed both in physical terms and organizational.

Secondarily, some of the greatest providers of the world are developing such solutions in Argentina for the reasons we have spoken into the first paragraph, especially in relation to the development of e-services for the public sector.

From the methodological point of view, it has been defined a firms sample equal to 112 in comparison to the universe represented by the total of the enrolled enterprises to the Cámara de Empresas de Tecnologías de Información de Argentina. The sample is representative of the phenomenon because it represents the 76,3% of the developers of e-services resident in Argentina. Today we have conducted 86 interviews finalized to verify:

- The existence of emergent methodologies in the processes of development;
- The characteristics of such emergent methodologies;
- The motivations that have pushed the developers to use more methodologies.

The first results of the research can be so resumed: the 13% of the Software Houses use owners methodologies and don't think to change; 64% of the interviewed have changed at least once the methodologies of development in comparison to a same project, the 23% of the interviewed ones are finally appraising to change. We have focused the attention on the second and third class. The first ones has put in evidence among the motives that have pushed to change the scarce productivity (40%), changes in the clients demands (71%), the rigidities of the methodology (35%),

finally the complexity (48%). It is important to underline that interviewed perceive the complexity as an increase of the requirements of integration and coordination between technology and structure. The third group of interviewed, also perceiving the same problems just underlined, has not changed methodology of development because it is evaluating the amount of new costs of research and development (80%). Such firms will probably opt for a change in relation to the lower cost of the qualified manpower. Particular attention has been turned to the characteristics of the new adopted methodologies. In 89% of the cases deal with SOA that however respect to firms in which have been adopted, have assumed particular characteristics (see paragraph 3).

The integration and the coordination of the processes can be simplified using technologies of integration between SOA and web services [6].

A web service is a part of a software that adapts a series of standard of exchange of information. These standards let the exchange of operations among different types of computer, independently from the characteristics of the hardware that use, the operational systems and the programming languages. To maintain their autonomy, the web services, encapsulate the logic inside a context. This context can be any logical cluster [7]. An Services Oriented Architecture – SOA – represents a methodology to realize the interoperability between applications and web services, to allow to re-use the existing technologies [8]. Since these services can be used by different systems and bases, the characteristics of the Web Services are ideal for the development of the e-service.

Models of Cycle of Life for the Development of E-Services Through SOA

The Models of Cycle of Life (MCLS) ad-hoc is formed by a series of phases or steps required to obtain a SOA solution starting from a necessities cluster well defined. Although the Models of Cycle of Life for projects SOA are based on the pillars of the cycles of life for distributed solutions, the same ones require of adaptations to obtain a qualified product [9].

In comparison to the cycle of life of the software they have been observed at least three separated approaches:

1. *MCLS SOA with focus Top-Down*: The strategy top-down used to build solutions SOA generates products of high quality. The resulting architecture with this focus will be good because the informative flow can be analyzed in an integral way, and then to lower the detail level until the services to implement. The main disadvantage of this focus is the budget and times.
2. *MCLS SOA with focus Bottom-Up*: The focus bottom-up establishes a different perspective during the analysis. The model suggests to begin to build the services starting from punctual requirements, for example, to establish channels of integration point to point among systems, or to replace solutions of remote communication of applications for a protocol multiplatform like SOAP (Simple

Object Access Protocol). Many times these requirements can simply be solved implementing services in modules of a system already existent. The organizations could see advantageous to this model because it allows them to integrate their systems using new low cost technologies [9]. Even if these implementations could be successful, and allow to achieve their punctual integration, they would not be framed in an architecture designed to take advantage of the Orientation to Services in their maximum expression. The solutions developed under this Model are not conceived to support a great number of services in a consistent, robust and agile way.

3. *MCLS SOA with Agile focus*: With the purpose of finding a focus that allows to incorporate the principles of architecture guided to services into the e-services atmospheres, without necessity waiting that the process has implemented in the whole organization, some firms are using the MCLS with agile focus [10]. The modality of work of this model differs broadly respect to the previous ones, because the analysis of the flow is executed in parallel to the design of services and development. This work form has a component of additional effort and additional costs [11]. This is due to the necessity of having to adjust the built services to align them with those business models that can change during the analysis activities.

Research's State

Today the research group is completing the quantitative phase of the investigation. (26 interviews still to realize). Nevertheless, an important tendency has been individualized that is when the level of organizational complexity increases, then increases the application of different development methodologies. In fact, it has been observed that the 77% of the Software Houses interviewed have changed development methodology in comparison to a same project. Even if the proposed questionnaire asked to the firms to point out the principal change motivations (see paragraph 2), it has been retained to plan a focus group among the principals project owners (developers) of such firms.

This last phase of the research will be performed within December 2007. It appears the most delicate, because to understand the motivations subtended to the change it indirectly allows to give a more punctual definition of the concept of complexity within the software development.

The considerations that derive from the analysis of the first research results are extremely interesting. The former is that change has to be considered as a physiological element in the software development [12]. It would be expedient a better evaluation on the subtended motivations to the use of the owners methodologies that probably aren't able to answer to flexibility demands especially in terms of R&D cost. The latter is connected to the SOAs diffusion. It would be expedient to understand in a better way the connected organizational aspects to the use of such models.

References

1. Fitzgerald, B. (1994). The system development dilemma: Whether to adopt formalized systems development methodologies or not? In W. Baets, (Ed.) *Proceedings of the Second European Conference on Information Systems* (pp. 691–706) Holland: Nijenrode University Press
2. Fitzgerald, B. (1997). The use of systems development methodologies in practice: A field Study, *The Information Systems Journal*, 7(3), 201–212
3. Lopez, A. (2003). La sociedad de información, servicios informáticos, servicios de alto valor agregado y software, http://www.cepal.org/argentina/noticias/paginas/3/12283/Resumen334B.pdf, Ministerio Argentino de Economía y Producción. Cited March 2003.
4. Ministerio Argentino de Economía y Producción (2003). *Plan De Acción 2004–2007*, White Paper
5. Fierro, P. (2005). Metodologie deliberate e metodologie emergenti nello sviluppo dei sistemi informativi complessi: Il caso di un Ente Locale. In F. Cantoni, Mangia G (Ed), *Lo sviluppo dei sistemi informativi*, Milano: Franco Angeli
6. IBM (2005). *IBM SOA Foundation: providing what you need to get started with SOA*. White paper
7. Erl, T. (2004). *Service Oriented Architecture Concepts Technology And Design*. Englewood: Prentice Hall
8. Woods, D. and Mattern, T. (2006). *Enterprise SOA: Designing IT for Business Innovation*. Cambrige: O'Reilly Media
9. Newcomer, E. and Lomow, G. (2005). *Understanding SOA with Web services*. Upper Saddle River, NJ: Addison-Wesley
10. Doddavula, S.K. and Karamongikar, S. (2005). *Designing an Enterprise Application Framework for Service-Oriented Architecture*. White Paper. Infosys
11. Zamora, V. (2006). *Integración Corporativa basada en SOA y Sistemas Inteligentes Autónomos*. Reporte Técnico. Buenos Aires: Laboratorio de Informática de Gestión. Facultad de Ingeniería – UBA
12. Avison, D.E. and Taylor, V. (1997). Information systems development methodologies: A classification according to problem situation, *Journal of Information Technology*, 12, 73–81

Selecting Proper Authentication Mechanisms in Electronic Identity Management (EIDM): Open Issues

P. L. Agostini[1] **and R. Naggi**[2]

Abstract Pursuing authentication through appropriate mechanisms for e-government procedures is a complex issue. The problem is not a technological one: from this point of view, the set of available authentication devices may be considered mature and stable. Major difficulties seem to arise from the fluidity of juridical taxonomies and of guiding-principles on which methodologies to select appropriate authentication mechanisms have to be established. Besides, e-inclusive policies and regulations have largely multiplied the number of variables to manage. In this scenario, effectiveness of available approaches and methodologies to support public bodies in their authentication choices may be legitimately questioned.

Introduction

In electronic IDentity Management (eIDM), authentication has the function of corroborating claimed identities of entities in order to generate a reliable context in which it is possible to insure legal certainty to transactions that take place through an electronic modality [1]. In other terms, the basic legal issue when implementing authentication procedures is to reach, in the on-line modalities, the same level of legal security represented by traditional channels [2]. The theme of the identification of appropriate authentication mechanisms is a main one for both e-commerce and e-government applications [3]. This work focuses on the second scenario. A widespread diffusion of trustworthy online authentication mechanisms is unanimously considered as a key enabler to allow e-government a further significant progress, particularly for high impact services [4]. In fact, considering that earlier authentication devices as digital signatures were introduced in the Italian and German juridical systems in 1997 and that the UE directive regulating electronic signatures was

[1]Università Cattolica del Sacro Cuore, Milano, Italy, pietroluca.agostini@unicatt.it
[2]Università LUISS – Guido Carli, Roma, Italy, raffaella.naggi@tin.it

issued in 1999, the rate of diffusion of authentication mechanisms for e-government applications among common citizens is not considered adequate. The set of available authentication devices is technologically mature and stable. Therefore, we can suppose that some of the main problems affecting authentication procedures come from approaches and methodologies adopted to select them. So, a main question arises: are available methodologies to identify the proper authentication mechanism effective?

In order to frame the matter, the work proposes first an analysis of the involved juridical variables and their relationship, so defining the traditional perspective. Then the focus switches to a critical description of approaches and methodologies developed and utilized during time. Italian and German experiences are put in particular evidence for their earliness and significance. To verify whether or to what extent such methodologies may be considered still valid and effective, the work examines how recent e-inclusive visions and policies have changed the ethical and juridical scenario, possibly affecting value taxonomies on which existing methodologies were originally based.

The Traditional Juridical Framework

What follows is a brief analysis of the traditional juridical tasks pursued through authentication and of the variables used in the methodologies developed to identify the appropriate mechanism.

Authentication as an Instrument for Generating a Legal Vinculum: From Identifiability to Bindingness and Non-Repudiability

The possibility to impute in an unequivocal way a specific message to a specific subject (authenticity) is one of the fundamental requirements for obtaining communications that may be considered valid from a legal perspective. This means that an authenticated communication requires the identification of – or the possibility to certainly identify – the actor who executes it and the integrity of the message as it was depicted by the sender. Equally important is the identifiability of the actor who receives the communication [2, 5]. In fact, the bindingness of a declaration is strictly related to the legal force of the identifiability of the parties and to the integrity of the communicated message. According to this understanding, the strength of the legal vinculum that has been obtained through authentication provides the environment for gaining the non-repudiability of enacted transactions. In turn, non-repudiability is the instrument to gain legal certainty and, consequently, trustworthiness. Moreover, when the written form is required, in many European juridical systems on-line communications have to be accompanied by qualified electronic signatures [6].

Authentication as an Instrument for Safeguarding Data-Protection: From Addressability to Confidentiality

A second group of legal issues materialises from the pursuit of the confidentiality of communications. Therefore, a main prerequisite is that the message content is not rendered to unauthorised actors. During the 1990s the ethical value "confidentiality" has become a legal duty. In most of the countries, data-protection regulations punish with administrative, civil and even penal sanctions unlawful data processing. If we take into consideration electronic communications, the crucial point in the pursuit of confidentiality is to achieve "addressability." Namely, it is essential that messages are transmitted to the correct addressees [2].

Authentication as an Instrument for Protecting Counterparts from Risks Related to Identity Abuses

According to general legal principles, authentication has also a function of protection from identity abuses. Identity abuses implicate the fact that specific legal acts could be imputed to unaware citizens; on the other side, public bodies risk to provide benefits and services to ineligible users. This means that citizens' authentication devices have to be protected from potential accesses by non-authorized actors.

Approaches and Methodologies to Identify the Appropriate Authentication Mechanism

In Europe, Italy and Germany were the earliest countries, in 1997, attempting to introduce authentication devices characterised by a structured legal acknowledgement. Italy pursued an immediate widespread diffusion of its new "digital signature" by making it compulsory for accessing important procedures and ser-vices of the Chamber of Commerce. Germany did not press the adoption of its digital signature. In 1999, the CE Directive n. 93 established the European juridi-cal framework for electronic signatures. In the "after-Directive" phase, Germany, through the Bundesamt für Sicherheit in der Informationstechnik – BSI (Federal Office for Information Security), distinguishes itself for what may be considered the most structured and complete work in the authentication research field.

The Earliest Italian Approach

In Italy, the earliest approach was to maximize the level of bindingness, so achieving the maximum level of non-repudiability; therefore, the Presidential De-cree

513/1997 attributed to the messages accompanied by the new "digital signature" the maximum bindingness strength, through a "iuris et de iure" presumption, and the dignity of the written form. It was also an attempt to use a unique mechanism of authentication, based on the idea that a "heavy" device would be suitable for every context. Confidentiality would have been preserved through encryption. At that time, addressability was less crucial than today: the exploitation of the internet as an instrument to communicate with citizens was still to come.

A completely underestimated aspect was the dangerousness deriving to completely unaware citizens from the simple ownership of an instrument so powerful in terms of bindingness. Indeed, protection from identity abuses has been centered on the holder's capacity to protect his/her smart card and pin-code.

The 1999 UE Approach

The 1999/93/CE directive, partially denied the Italian approach attributing juridical dignity to different categories of electronic signature, characterized by diverse levels of bindingness. The prevailing idea was that on-line communications and transactions required differentiated levels of bindingness – and even of confidentiality – so giving the possibility to accommodate authentication mechanisms to the needs of the specific situation. This solution, because of its flexibility, appeared more appropriate to pursue a series of objectives, like the reduction of costs (for both public bodies and users) and of the level of dangerousness for citizens. On the basis of this new perspective, bindingness and confidentiality are no longer static objectives, but dynamic ones and their intensity has to be context-related. In other words, the differentiation of legal mechanisms would have allowed to generate a level of identifiability proportioned to the required level of bindingness and to simultaneously generate a level of addressability proportioned to the required level of confidentiality.

The BSI Methodology

Dynamic relationships between identifiability and bindingness, and between addressability and confidentiality, have been investigated in a significant way mainly in the German research project correlated with the issue of the BSI E-Government Manual. On the basis of the consideration that different authentication devices achieve different levels of identifiability and addressability depending on their configuration (structural elements), the BSI methodology classifies 11 existing mechanisms according to the strength of authentication [2]. Through such classifications, public bodies implementing authentication devices are able to identify appropriate mechanisms, so achieving the levels of bindingness, confidentiality and protection required by a specific application.

The most innovative feature of the BSI methodology is that protection from dangerousness of authentication devices has been acquired as a main requisite.

Nevertheless, the evaluation of the levels of identifiability/bindingness is still based on the force of legal presumptions, instead of on the actual citizen awareness of risks and responsibilities.

A new Framework to Approach the Matter

Citizen-friendliness has increasingly become an important element for assessing e-government solutions [7–9]. The "i2010" European Commission's strategic policy framework and the related Ministerial Conferences, as "Riga 2006," have definitively ratified an e-inclusive vision of e-government, with a direct effect also on eIDM.

The New Principles and Recommendations of the Organisation for Economic Co-Operation and Development (OECD)

The recent OECD "Recommendation" [3] delineates the new reference framework for eIDM according to an e-inclusive vision. Risk management definitively moves in the direction of a balanced allocation of authentication risks. Education and awareness of proper use of authentication and of risks and responsibilities are now considered pre-requisites for a widespread diffusion of electronic devices. Gaining usability becomes a main operative principle. It is important to underline that the concept of usability encompasses the minimisation of risk associated with use. The OECD "Recommendation" indicates a series of "foundation" and "operational" principles, but does not propose any methodology related to the theme we are examining.

Accessibility and Usability as Juridical Requirements

While the OECD document may be considered as a fundamental step towards the statement of a new reference framework, it does not develop a juridical question that seems still quite underestimated.

In different legislations, main features of citizen-friendliness, as e-accessibility and usability, have been the object of legal regulations (e.g. the Stanca Law 4/2004 in Italy or the BITV in Germany). This means that such features are no longer exclusively ethical requirements, but they have become compelling vincula in e-government process implementation, thus involving eIDM. The problem was pointed out also by BSI in Germany [7]. Nevertheless, the solution to exploit the legal exception that admits the use of non-accessible devices until accessible ones are on disposal appears unconvincing, both in a juridical and in an ethical perspective. A too extensive interpretation of such exception could allow getting round the main scope of accessibility laws. In a more rigorous reading, accessibility and usability

have to be taken in consideration as parameters having at least the same juridical dignity as bindingness and confidentiality.

Conclusion

During the last ten years, approaches and methodologies to identify suitable authentication mechanisms seem to be reflecting the different relative values attributed to administration efficiency and ethical aims. Earlier approaches had been finalized to determine the mechanism responding mainly – if not almost exclusively – to efficiency purposes in a short term perspective, while a second generation of approaches has become more sensitive to ethical aims. Both types of approaches had to deal with legal vincula coming from existing data protection laws. Limits of first generation methodologies are self-evident. Not only their pure efficiency-driven approach is no longer ethically sustainable, but it might be questionable even whether mechanisms improved utilizing them can still be considered lawful. The main problem with second generation methodologies (after 1999/93/CE Directive) is that they have substantially continued to refer to juridical taxonomies developed under a non citizen-centered vision. In particular, they persist in accepting the non-contextualised legal presumptions on which the relationship identifyability/bindingness is based, without investigating whether such presumptions are still acceptable in a balanced distribution of risks and responsibilities.

In the current scenario, laws and EU directives of 1990s – still in force – compelling accessibility national laws, recent official operative recommendations [3] and ongoing pan-European projects [1] cohabit in an overlapping and not well coordinated manner. Some main questions appear as still unsolved. For in-stance, while the differentiation of mechanisms seems to be preferable, the proliferation of authentication devices is regarded as source of dangerous confusion for users and as a main obstacle to interoperability [3]. It is also important to notice that significant Courts' judgments are still completely absent: in law-related fields, this aspect aggravates uncertainty. Meanwhile, single public bodies are continuously issuing authentication devices most likely selecting them in an empirical way [10]. Such situation generates fluid taxonomies of juridical requirements and guiding-principles that, in conjunction with a variety of reference practices, seem to affect the same feasibility of effective methodologies.

References

1. European Community, Information Society and Media Directorate-General eGovernment Unit (2006). A Roadmap for a pan-European eIDM Framework by 2010. Brussels, Belgium. www.ec.europa.eu/information_society/activities/egovernment_research/doc/eidm_roadmap_paper.pdf
2. Bundesamt für Sicherheit in der Informationstechnik (BSI), *Fraunhofer-Institute Secure Telecooperation (FhI-SIT), NOVOSEC AG (2004). Authentication in E-Government*

(Authentication mechanisms and areas of application). E-Government Handbuch. Bonn, Germany: BSI. www.bsi.de
3. Organisation for Economic Co-Operation and Development (OECD) (2007). *OECD Recommendation on Electronic Authentication and OECD Guidance for Electronic Authentication*. Paris, France: OECD www.oecd.org/document/7/0,3343,en_2649_33703_38909639_1_1_1_1,00.html
4. European Community (2006). *COM(2006) 173 final. i2010 eGovernment Action Plan: Accelerating eGovernment in Europe for the Benefit of All*. Brussels, Belgium. www.ec.europa.eu/information_society/newsroom/cf/itemshortdetail.cfm?item_id = 314
5. CENDI (Commerce, Energy, NASA, NLM, Defense and Interior) Persistent Identifica-tion Task Group (2004). Persistent Identification: A Key Component of An E-Government Infrastructure. Persistent Identification Whitepaper
6. Kuner, C. and Miedbrodt, A. (1999). Written Signature Requirements and Electronic Authentication: A Comparative Perspective. *EDI Law Review* 143, Vol. 6/2–3, 143–154
7. Bundesamt für Sicherheit in der Informationstechnik (BSI), *Web for All, Forschungs-institut Technologie-Behindertenhilfe (FTB) (2004). Accessible e-Government. E-Government Handbuch*. Bonn, Germany: BSI. www.bsi.de
8. Carcenac, T. (2001). *Rapport Au Premier Ministre – Pour une administration électronique citoyenne méthodes et moyens*. Paris, France: Archives Premier Ministre. www.archives.premier-ministre.gouv.fr
9. Jakob, G. (2002). Electronic Government: Perspectives and Pitfalls of Online Adminis-trative Procedure. Proceedings of the 36th Annual Hawaii International Conference on System Sciences (HICSS'03). Track 5, p. 139b
10. Agostini, P.L. and Resca, A. (2006). L'efficienza degli eIDM tra citizen-friendliness e certezza giuridica. Come la questione è stata affrontata da tre Enti Pubblici Italiani. Proceedings of the itAIS 2006 Workshop on Information Systems and People: Implementing Information Technology in the Workplace (Università Bocconi, Milano, 26–27 October). Università Bocconi Milano, Italy

A System Dynamics Approach to the Paper Dematerialization Process in the Italian Public Administration

S. Armenia[1], **D. Canini**[1], **and N. Casalino**[2]

Abstract The dematerialization problem is still young, it hasn't been well analyzed yet and its definition is nearly absent in the literature. This paper concentrates on the problem with a methodological approach which will try to describe the underlying structures, the overall system behaviours, processes and stakeholders. We will give an interpretation of the not always linear relationships and of the feedback loops among the involved variables, also considering those soft interactions which typically arise in those complex systems connected with social environments and which often are not properly taken into account or even neglected. We will thus formalize a dynamical hypothesis so that, with a systemic approach, we can design a system dynamics model that may help us in validating those hypothesis and in building a useful decision support system, in order to provide the Public Administration Management with the chance to make policy analysis and strategic support concerning the major issues related to the dematerialization process.

Introduction

This study has been conducted with the support of CNIPA (Centro Nazionale dell'Informatica nella Pubblica Amministrazione [1]), the Italian National Centre for the Information Technologies into Public Administrations, on the matter of paper documents dematerialization. This problem does not only imply dematerializing paper archives, but also allowing the whole Italian Public Administration to switch to innovative processes and technology in order to progressively leave the old paper format for all kind of communications (internal or external). Our study started from legislative aspects and from those few studies on this subject. However we found

[1]Università di Tor Vergata, Roma, Italy, armenia@disp.uniroma2.it, stitch7@alice.it
[2]Università LUISS – Guido Carli, Roma, Italy, ncasalino@luiss.it

evidence in the literature, that some Italian experts derived several expectations around the dematerialization process in the national Public Administration (PA). Thus the hypothesis we wanted to confirm and enforce (also by supporting them with simulation results), were those eventually contained in the so called "White Book concerning the Dematerialization in the Italian Public Administration." These hypotheses and goals [2–4] are described as follows:

- To reach cost containment results *before the end* of the second year after the start of a massive dematerialization process;
- To model the dematerialization process in the Italian Public Administration, starting from the process analysis up to describing the relationships among the various parts of the system;
- To analyze and set the model in order to validate the experts results (Early Model simulation) and to provide a decision support tool which may enable in studying and understanding further and future developments in the model/system.

Method of Survey and Model Representation

We developed a *causal map* [5] of the dematerialization system by first analyzing the problem of the adoption and diffusion of a new technology, basically making use of the "Bass Model" [5] (effective adopters of the new technology grow in number since they tend to spread into the relevant population and thus the "epidemic" contact becomes more and more likely to happen). We introduced also some aspects like the word-of-mouth effect as well as the influence that a marketing campaign may have. We also introduced an abandoning rate from the new technology, that is those users who are unsatisfied with the new technology and thus revert to the older one. We didn't however explicitly consider those who "jump on the next innovation curve," since we neglected their influence for the scope of this work. We also analyzed the influences that an electronic document average costs have on the diffusion of the new technology, with the assumption that a wider diffusion of the new technology would in the (not so) long run pull down the document production costs, then again allowing for a further positive effect on the technology diffusion. At last, we also introduced some other issues acting in the system, like the "saving of paper" (in terms of "kg") and "occupied storage volume" (in terms of cubic meters). The following is the resulting casual map:

The causal map of the relationships, which act in the system, has been kept minimal for the scope of this work even though the relations among the variables have been validated by CNIPA experts as well as it has been found evidence of such relationships in the relative literature (dematerialization and system dynamics) (Fig. 1). Starting from the causal map, we proceeded on to building a stock and flow model, that is a system dynamics model. Over a 10 years period, we simulated several scenarios by trying different policies for the introduction of the digital document format. The simulation has allowed us to first draw some realistic

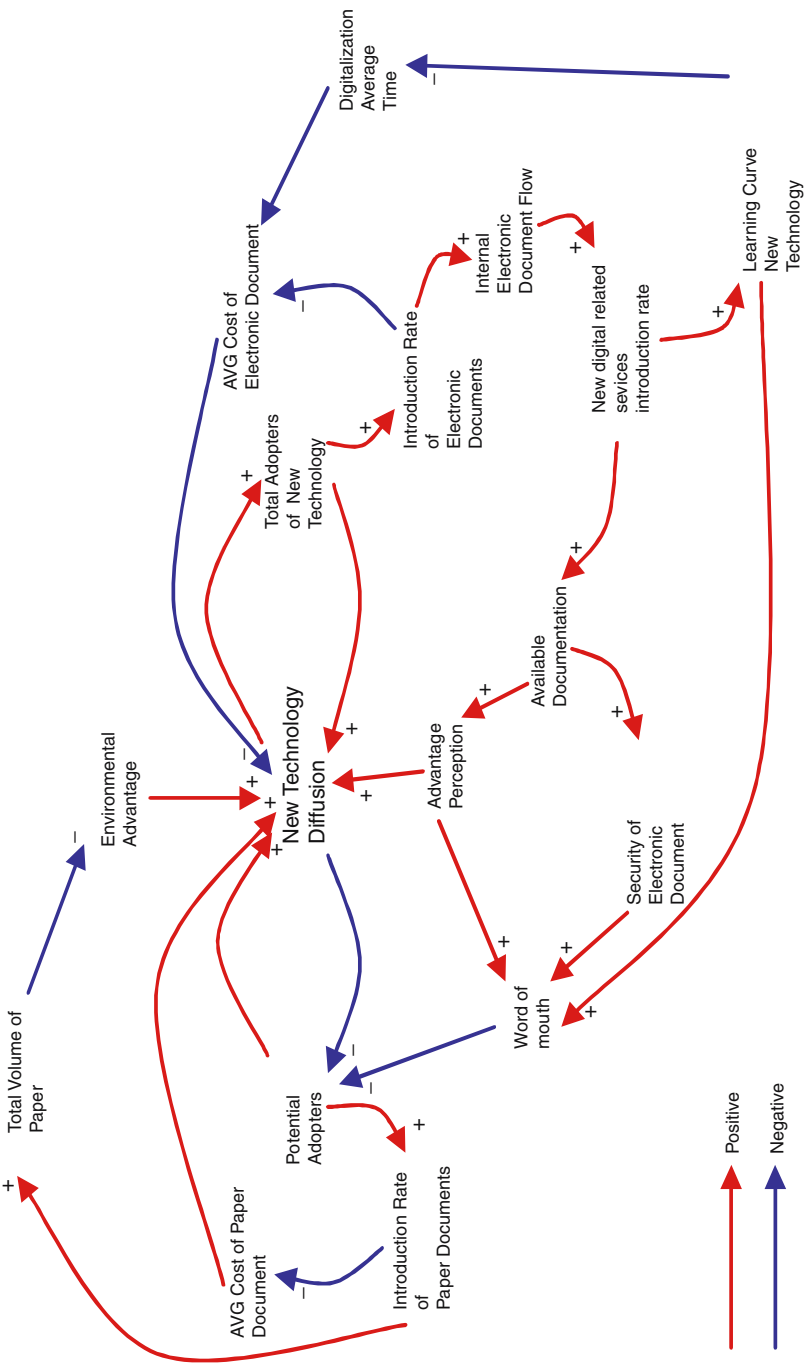


Fig. 1 The causal map

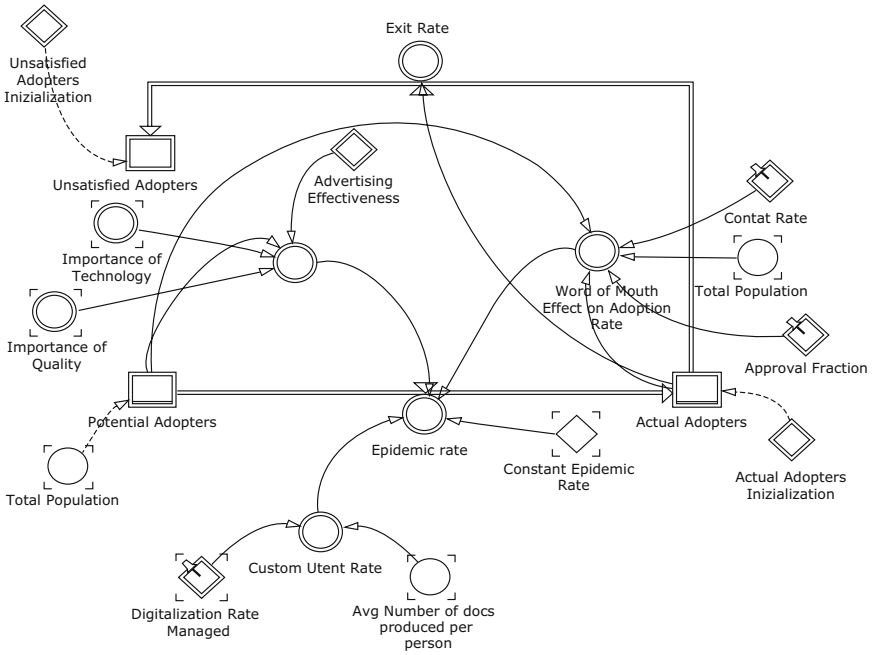


Fig. 2 The adopters World

conclusions on the values of some parameters of the system, and then to validate the robustness and the reliability of our dynamical hypothesis as well as to check if they were well founded, since they were drawn by the experts expectations. The model basically describes two main processes. The process of technology adoption which puts in strict relation the PA and its customers (i.e. the citizens) and the process of real document dematerialization, which consists in the transformation of paper documents into electronic ones as well as the introduction of documents directly into electronic format. As shown in Fig. 2, the first sub-model basically reflects the process of technology adoption by means of the Bass-model $(\mathrm{Nt} = \mathrm{Nt} - 1 + \mathrm{p}(\mathrm{m} - \mathrm{Nt} - 1) + \mathrm{q}(\mathrm{Nt} - 1/\mathrm{m})(\mathrm{m} - \mathrm{Nt} - 1)$ where: Nt = Actual Adopters at T; m = Potential Adopters; p = Adoption Probability; q = External influence probability) structure:

A relevant aspect is the epidemic rate, which has been modelled as the linear combination of two functions: the first, on the PA side, which is mainly due to marketing campaigns and to investments in quality and technology; the second is concerned instead about the effects which mainly derive from the "word-of-mouth" among the people which are part of the system. An opportune weighted sum of such functions determines the switching rate to the new technology (measured in usr/yr). As shown in Fig. 3, the second sub-model represents instead, the "Documents World," that is the documents state transitions from paper to electronic (measured in doc/yr).

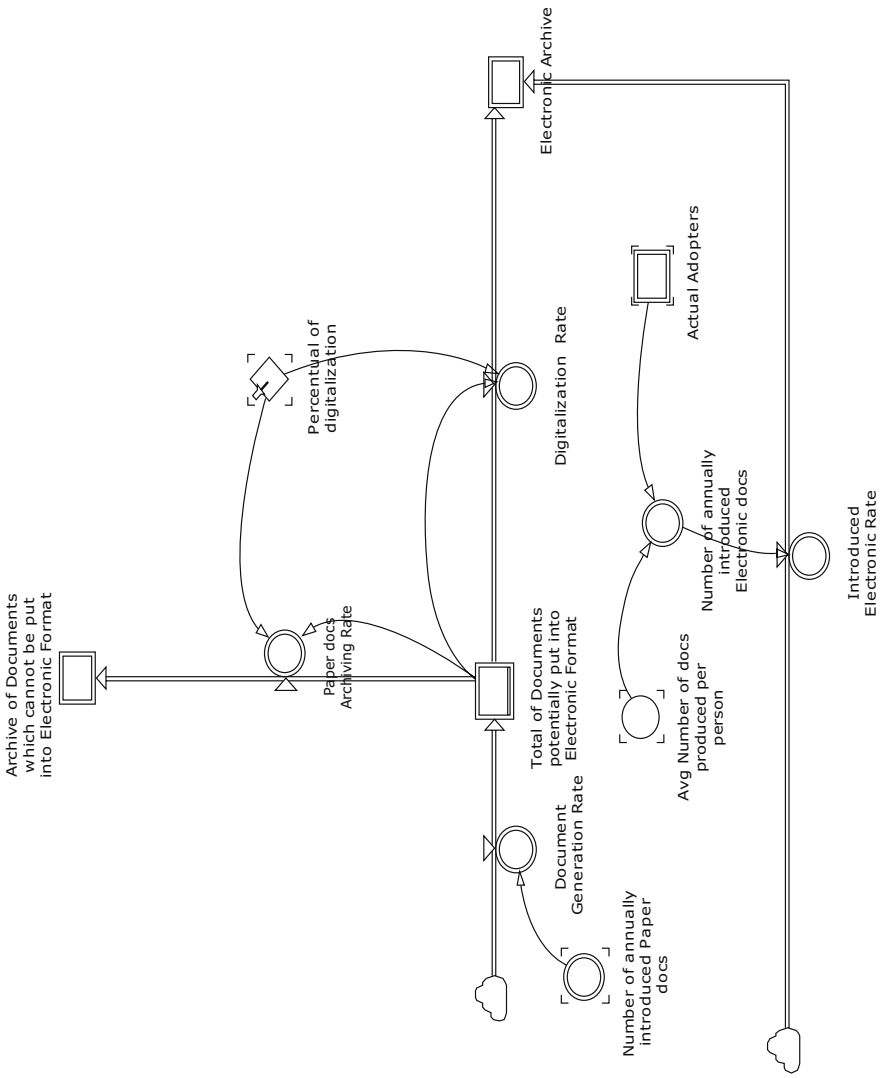


Fig. 3 The documents World

For length reasons, we won't delve in this paper into further details on cost functions or on typical soft effects like word-of-mouth or customer satisfaction, which, moreover, for simplification reasons, have been kept very simple in their definition or curve shape.

Simulation Results

The positive impacts of investing in "quality" has started to become evident approximately at the beginning of month 10 in the simulation, and the dematerialization process converges at the desired value between the sixth and the seventh year of simulation (carried out over a 10 years period). Before the 10th month, the negative contribution is mainly due to the fact that initial investments in quality and an initial increase in the cost of production of electronic documents can cause and intrinsic increment in the average costs of general document production, thus also generating an intrinsic delay in the adoption of the new technology (since the first perception of the users is negative because of the increment in the costs), and only after a while, the marketing *stimulation* effects start to be evident, also because the effective adopters start to sensibly increment in quantity. In fact the epidemic rate has its peak around the second year of simulation. A general equilibrium is thus established around the third year. These results are totally consistent with the expected results shown in the "White Book concerning the Dematerialization in the Italian Public Administration" [3], by the Inter-Ministry Workgroup for the dematerialization. The starting goal of creating a simulation model, capable to describe the organizational and managerial structures, as well as fit the behaviour of the as-is system, has thus been reached. Moreover, data obtained by the optimization have produced quite convincing results (though to be taken as a first mathematical and dynamical interpretation of the dynamics of dematerialization), thus generating an added value to the organization which initially committed this study (CNIPA). Such an added value, again, is that of having a model which correctly depicts the behaviours of the various processes by systemically taking into account the dynamics of the involved structures. In order to prove these results, a graphical interface has been designed, that is an interaction tool capable of customizing input data (though constrained to the identified feasible ranges) in order to provide the chance to experiment with different "what-if" scenarios. Several aspects have been then made customizable, allowing the decision-taker to experiment with different geographical dimensions (at local, urban, province, region or national level) in a simple and intuitive way. The "world" may thus be defined by initializing the desired parameters also in terms of costs and several other aspects.

At the end, the model created provides both a careful reconstruction of exogenous and endogenous dynamics in the process of dematerialization which is actually carried over into the Italian PA, allowing to examine the behaviour of the overall system and understand the structures which enable such dynamics; in other words, our

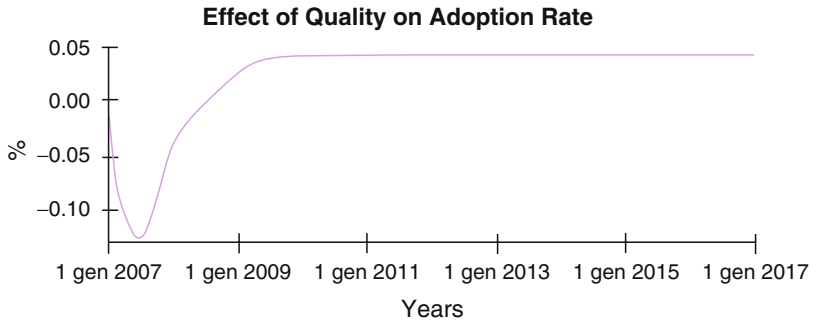


Fig. 4 Effect of service quality on adoptions

model has allowed us both to understand the root causes of the identified dynamics as also to identify those high leverage structures which in the end enabled us to build a (still simple) decision support system that will allow the decision maker to experiment with the model and try to anticipate possible evolutions of the dematerialization process, as well as also anticipating its possible risks and advantages. Some of the obtained results have been expressed in the following graphs (on a time window of two years) which is a sufficient temporal horizon that allows us to derive significant knowledge by examining the behaviours of the variables at play (Figs. 4 and 5).

We can observe the initial fall due to the investments in quality. These costs actually act negatively at the beginning before the effects of the newer technology start to be perceived as positive, thus affecting positively the adoption rate rather than only the negative effects of direct costs. On a 2 years scale, we can observe the peaking of the Adoptions between the third and fourth year of the simulations (Figs. 6 and 7).

We can see the systemic stability at the end of the third year and the environment achieved a general equilibrium. The adoption rate peaks at the beginning of the third year after the introduction of the dematerialization process (Figs. 8 and 9).

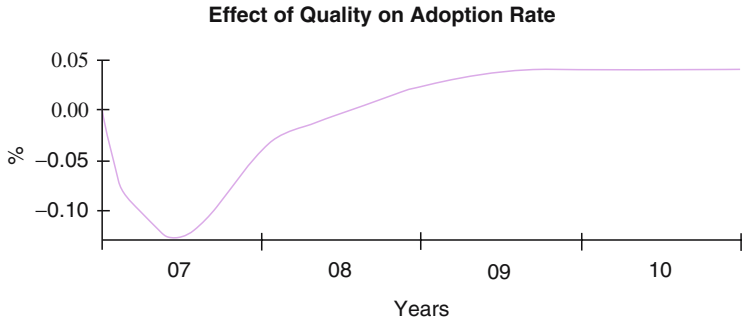


Fig. 5 Effect of service quality on adoptions (2 years focus)

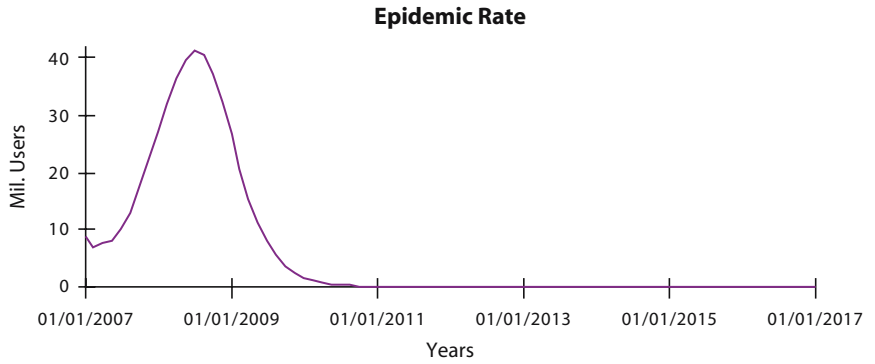


Fig. 6 Adoption rate

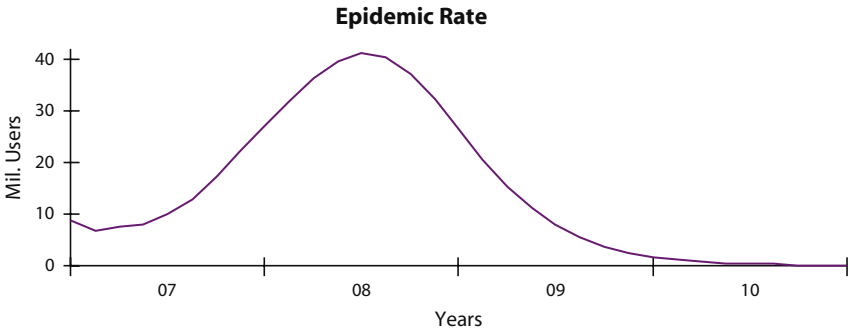


Fig. 7 Adoption rate (2 years focus)

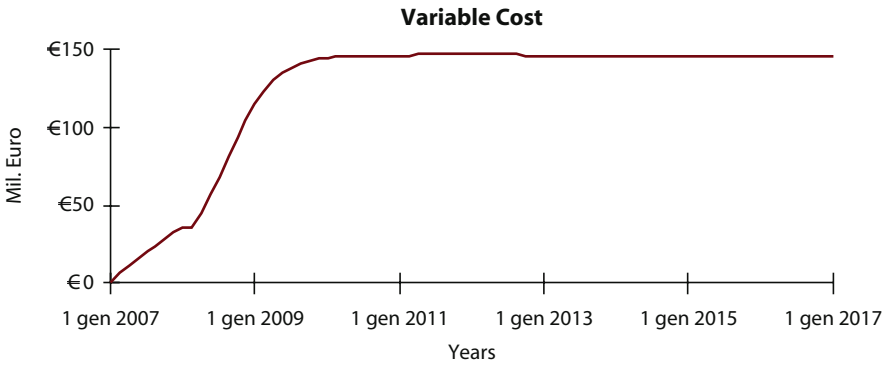


Fig. 8 Variable costs of digital documents production

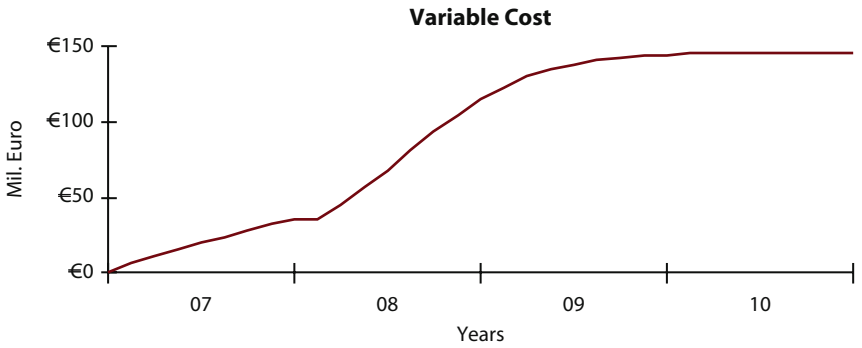


Fig. 9 Variable costs of digital documents trend

Conclusions

Our analysis allowed us to build a model which has been able to help us to demonstrate our initial dynamical hypotheses, thus technically and mathematically validating those expert studies, which hypothesized for the PA to reach an added value for the dematerialization process around the end of the second year after the introduction of the "new technology." Besides, particularly interesting has been the evaluation of the quality weight over the epidemic rate, since we were able to define an economic range in which investments in the new technology are reasonable and feasible. In the end, our research provides, at its actual stage, important issues in order to effectively carry out the process of dematerialization into the PA environment, by pointing out its eventual advantages. Among these, we can surely name: savings on the citizens side (reduction of average document costs), general time saving in document management or production, increment of safety storing, extreme simplicity and quickness of document retrieval. Along with these direct and immediately quantifiable impacts, it's also important to take into account the savings in terms of paper production as well as the impacts on the environment.

References

1. CNIPA – Centro Nazionale dell'Informatica nella Pubblica Amministrazione, www.cnipa.gov.it.
2. CNIPA (2006). The dematerialization of administrative documentation, Quaderno n. 24.
3. CNIPA (2006). White Book concerning the document dematerialization in the Italian public administration, InterMinistry WorkGroup on document dematerialization by means of electronic formats.
4. Ridolfi, P. (2006). Document dematerialization: Ideas for a roadmap, CNIPA, Italy.
5. Sterman, J. D. (2000) *Business Dynamics. System thinking and modelling for a complex world*, Irwin, McGraw Hill.
6. Integra module. Il Pensiero sistemico, Systems Thinking, http://odl.casaccia.enea.it.

7. Longobardi, G. (2001). Cost Analysis on the automation of document production, CNIPA.
8. Ossimitz, G. (2000). Development of systems thinking skills, Klagenfurt University 3(2): 26.
9. Sterman, J. (2002). All models are wrong: reflections on becoming a systems scientist, System Dynamics Review, 18(4): 501–531.
10. Morecroft, J. D. W. and Sterman, J. (1994). Modeling for learning organizations, Portland, OR, Productivity Press, 3(8): 85–87.
11. Burns, J. R. (2002). A matrix architecture for development of system dynamic models.In *Proceedings of the 20. International Conference of the System*, Dynamics Society, Palermo, Italy, July 2002.
12. Burns, J. R. (2002). A component strategy for the formulation of system dynamics models.System Dynamics Conference 2002.
13. Radzicki, M. J. (2003). Foundation of system dynamics modelling.
14. Senge, P. (1990). *The Fifth Discipline*, Milan, Sperling & Kupfer.
15. Hanneman, R. (1988). Modeling dynamic social systems – computer-assisted theory bulding, Newbury Park, CA, Sage.

Public Private Partnership and E-Services: The Web Portal for E-Learning

L. Martiniello

Abstract This paper concentrates on Public Private Partnership (PPP) as the main instrument for providing e-services to Public Administrations (P.A.). The objective is to identify the basic element necessary to undertake a PPP in this field and the implementation warnings for the success of this kind of projects. After a brief description of the e-services market and of the new legislative framework, I will consider the importance of Value for Money (VFM) and risk transfer as main elements of a procurement process. In particular, I will present a preliminary case study about the possibility to realize a web portal for e-learning services managed though a "concession of service" contract with the aim of reducing costs and risks, increase competition and ensure a VFM approach.

Introduction

Public Private Partnership (PPP) has been widely used in many countries since 1992. It is based upon the idea that private sector expertise, including finance raising, can provide services which traditionally would have been provided directly by the Public sector. In 2006 the new code of public work (D.lgs.163/2006) seems to underlined the importance of "private initiative" as an instrument also for public services supply, enlarging (with a new comma added at the art.152) the "private initiative" discipline also to services.

In the past some authors considered the importance of PPP for e-government and identified some difficulties to PPP and Project Finance (PF) development mainly due to "*the absence of clearly defined models to undertake the partnership and to inadequate rules and laws*" [1].

Now the scenario is slowly changing because of better rules and laws; because of the new models available and because of an increasing experience in the difficulties arising during a PPP. According with the new Dlgs. n.163/06 it is possible for a

Università LUISS – Guido Carli, Roma, Italy, lmartiniello@luiss.it

private bidder to present an initiative to the P.A. and if the initiative is judged to be of public interest it will be realised according to the procedure in the past applied to the construction of public infrastructures.

The wish of the private to deliver innovative services to public administrations and the interest of the P.A. toward solutions value for money oriented makes both potentially interested in a wider range of partnership chosen according to the characteristics of each project.

While in some cases e-services are required directly by the P.A. in other cases it became possible that they are proposed by a private promoter. In both cases the installation of a collaborative environment and the development of a proper legal framework is essential for guiding cooperation and service execution [2].

PPP and E-Services

Public Administration services can be performed and provided more efficiently, and at lower cost, by developing and using electronic interactive device [3].

The knowledge and skills of the private sectors are essential in the ICT field as the ability of the private partner to manage the service provided.

E-service under development in Italy concern in particular:

- Knowledge management;
- Business intelligence;
- E-procurement;
- CRM system;
- Privacy and Security;
- E-learning;
- Web portals for services;
- etc.

The necessity to deliver these innovative services to public administrations make it necessary the research of solutions VFM oriented. This means to identify the main advantages of each potential partnerships; the connected risks and the effect on the costs and quality of the public services provided [4].

In particular according with the project finance theory we can identify some preconditions necessary to undertake a PPP and in particular a project finance for e-services:

- A well identified technology;
- The potential interest of the market;
- Particular skills and knowledge of the private partners (ability to reduce risks);
- Economic and financial balance of the project.

In the majority of the potential projects, PPP for e-service seems respect all these conditions. It is important to underline the importance of the economic and financial balance of the projects. It can be determined on the base of a public or private

contribution but a fair profit has to be guaranteed to the private partner while the advantages for the P.A. is the possibility to state in advance the contribution, transfer the construction and management risks and introducing some "success fees" connected to performance indicators [5].

Value for Money and Risk Transfer

In Italy as in the majority of European and Mediterranean countries public sectors is developing and implementing new e-services. E-services are not a cutting edge but a system to ensure efficiency and effectiveness cutting at the some times the costs of the services supply. This means that a P.A. planning the introduction of such services has to make clear his objectives and the way to reach them. In this context it becomes essential for the P.A. to act in the direction of an efficient procurement procedure and of an appropriate contractual agreement with the private bidder.

The current theoretical framework define it a VFM approach. Value for money (VFM) can be defined as "the optimum combination of whole-of-life cost and quality of the good or service to meet the user's requirement" [6].

Every administration should be able to ensure that the project will realise VFM. To do this procuring authorities need to evaluate the advantages of a certain choice and to introduce accounting methodologies to quantify the VFM created. The evaluation methodologies all rely on a very important concept "risk assessment" [7].

An increasing risk transfer to the private sector, combined with a more aggressive financial structure, can produce a strong effect in terms of VFM but P.A. must be able to arrange the best available deal. Partnership with private companies must ensure value creation, cost reduction and the increase of efficiency and effectiveness.

From a literature review and from the past experiences of P.A. in the PPP field it is possible to identify some implementation conditions that a P.A. should respect to ensure a VFM oriented project:

- Clearly defined objectives;
- A proper feasibility study;
- A sufficient level of competition;
- Risk transfer;
- "Success fee" mechanisms;
- Monitoring and control during all project phases.

In addition to the identified procedural best practices is necessary to take into consideration the limits and the difficulties encountered in the past.

The first problem is the absence in the Italian P.A. of any experience in risk analysis and risk assessment. This led to contracts that do not seem to reflect any risk allocation with the consequence that all risks remain on the public sector causing a considerable number of legal actions.

Another problem is the lack of competition with the consequent difficulty to contract-out better conditions in terms of costs or quality.

A third problem concerns the poor monitoring system and the lack of monitoring and control procedures especially in the management phase.

We hope that the defined best practice and the awareness of the limit and difficulties of PPP could help public administration to develop PPP projects in e-services avoiding or reducing the problems encountered in traditional PPP projects.

From the Idea to the Field Study: E-Learning Portal

Italian government is affording a consistent investment at local and central level to make its personnel more productive. We are speaking of about 4 million persons with an average income between € 24,000 and € 36,000. Because by law the 1% of the total personnel expenses must be used for education it is possible to quantify the annual education budget in more than € 1 billion [8].

In this context it seems useful evaluating innovative educational solutions through a greater use of e-Learning and the adoption of interactive solutions. The continuous increase of the public debt and the problems that Governments every year must face to make public accounts fit with the National Budget determines a strong necessity to rationalize public expense and to increase the productivity on the job of the public employees. In this case technology adoption and diffusion must be evaluated also from an economic perspective.

This means to choose it if it represents the best available option and ensures an optimal allocation of risk between the subjects involved in the agreement. For example under certain conditions e-learning could be conveniently provided through a web portal in particular through a "concession of services" by a private or institutional subject able to design, build and manage a portal and its contents for the concession period. The aim of the P.A. should be: to receive quality services, to reduce costs and risks connected to an in house management of the project, involving private capital into the project. The contractual form to pursue this objectives could be a "concession of services" which answer better to the requirement of a clear risk transfer and of an higher level of competition among bidders; rather than mixed society in the past proposed as a good model for supplying e-services but presenting some governance and strategic problems.

The Costs and Benefits of an E-Learning System

As we stated before e-Learning could ensure consistent savings in the education sector. Every year the cost of traditional education goes from a minimum of € 107 to a maximum of € 855 per person in the different compartments. This amount if increased of some additional costs: transfer expenses, food, lodging, etc. led to

double that amount with an expenses between 214 and € 1,710, and with an average value of about € 900 per person.

The main advantages of e-learning is connected to:

- Strong scale economies;
- Repeatability of the courses;
- Greater choice for the users, (today in many cases obliged to follow classes they are not interest in);
- Lower travelling expenses, etc.

In addition the existing technology make it possible to implement such system also through open source platforms with extremely low costs.

In particular it has been quantified that the total cost of an e-learning infrastructure is due to:

- Infrastructure provision (Hw);
- Training material provision (M);
- Tutoring (T).

Because of the strong scale economy the cost per person could change radically according with the different fruition of that services that influence the costs of the infrastructure and tutoring.

Under the hypothesis of 100,000 users 10,000 of which on line at the some times the costs have been estimated as follows [9].

The total costs of the infrastructure, including the maintenance and management costs, could be about € 2,275 million. The total costs of each course, including set up, training material and tutoring could be around € 1 million. It is possible to assume that the unitary start up costs will decrease consistently over the time according with a growing number of users as well as the production costs of training materials.

If the P.A. should move from the traditional education to the e-learning only the 10% of its education budget the costs of the project would be completely covered. From the market perspective we would be in presence of a limited cost of the investments in correspondence of an ensured consistent number of users.

An advance purchase of a certain number of courses by the P.A., could ensure a certain level of demand that would allows a strong interest of private bidders toward an investment whose construction and management risks should lie completely on the private partner.

Apart from the sustainability of the project, the novelty concerns in particular its business model. The portal construction and maintenance could be financed by private funds and the educational contents could be provided by institutions like Universities, centre of study; etc. through a competitive system that leave the user free to choose the course on the base of a rating system (for example of a score assigned to each course by previous users) (Fig. 1). The benefit, in this case, could be a constant competition on quality because of the payment mechanism directly linked to the fruition of the courses and to their rating.

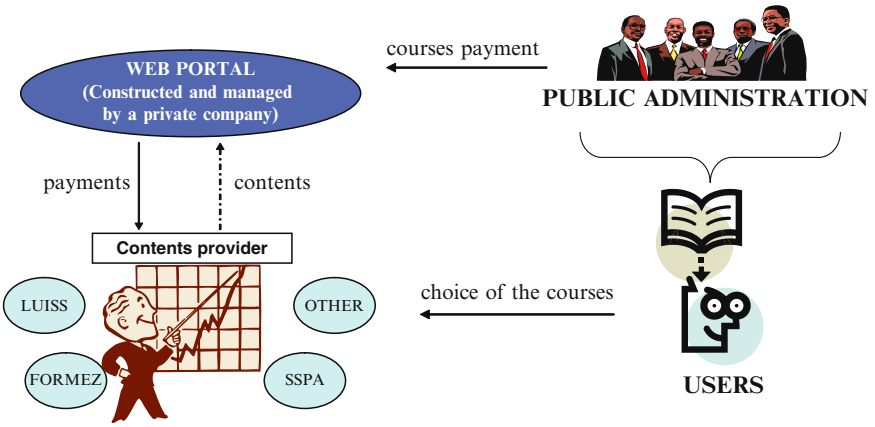


Fig. 1 E-learning portal: A new business model

Main Remarks and Conclusions

As explained in this paper e-services and in particular e-learning can be used to reduce costs and create VFM by using the private sectors skills and competences in providing services directed to the community or to the P.A. as a final user.

It is important to remember that PPP is a good model only if its implementation is value for money oriented and a good risk transfer is achieved. The main idea at the base of our paper is that the use of project finance could reduce the costs and improve the services quality comparing to different procurement models only under certain conditions and in presence of clear rules and shared aims between partners. In particular, this mechanism work, as it happen in other fields, if competition is used as a means to lower prices and the P.A. is able to contract out good conditions or fixed price for each e-service supplied ensuring the economic and financial balance of the project through a contract transferring the majority of the project risks to the private bidder.

The case study presented proposes an innovative model to develop e-learning services to the government exploiting the competition effects and the risk transfer as main VFM factors. This model is nearer to the so called unbundled models because the portal is managed by a private subject and the educational contents providers use the portal an independent service provider. The P.A. has only an external role in the projects, do not taking part in the industrial risk, except from an advance purchase of certain number of courses, paid ex-post on fruition bases.

References

1. Prister, G. (2002). Modelli di partnership per l'eGovernment nella pubblica amministrazione. *Sistemi e Imprese*. 5,81–85

2. Anthopulos, L., et al. (2006). The bottom up design of eGovernment: A development methodology based on a collaboration environment. *E-Service Journal*. 4,3
3. Virili, F. (2003). ICT nelle organizzazioni: le pietre miliari. In De Marco, Sorrentino, et.al. (Eds.) *Tecnologie dell'informazione nelle organizzazioni*: Milano, *CUESP*
4. Boyer, K.K., Hallowell, R., and Roth, A.V. (2002). E-service: operating strategy a case study and method for analyzing operational benefits. *Journal of operation management*. 20,175
5. Garson, D. (2003). Toward an information technology agenda for Public Administration. *Public information technology: policy and management issue*. Hershey,USA, IGI Publishing
6. Treasury, H.M. (2006). Value for money assessment guidance. www.hm-treasury.gov.uk. Cited 7 October 2007
7. Darrin, G. and Lewis, K. (2005). Are Public Private Partnerships value for money? Evaluating alternative approaches and comparing academic and practitioner views. *Accounting Forum* 29,345
8. Rapporto Eurispes 2001–2004. 7° Annual relation on education in public sector. www.sspa.it. Cited 8 October 2007
9. Unità tecnica finanza di progetto–UTFP (2006). Utilizzo del PPP per la nascita del portale della formazione on-line. http://www.utfp.it/doc_tecnici.htm. Cited October 7th 2007