Towards new challenges for Innovative management practices

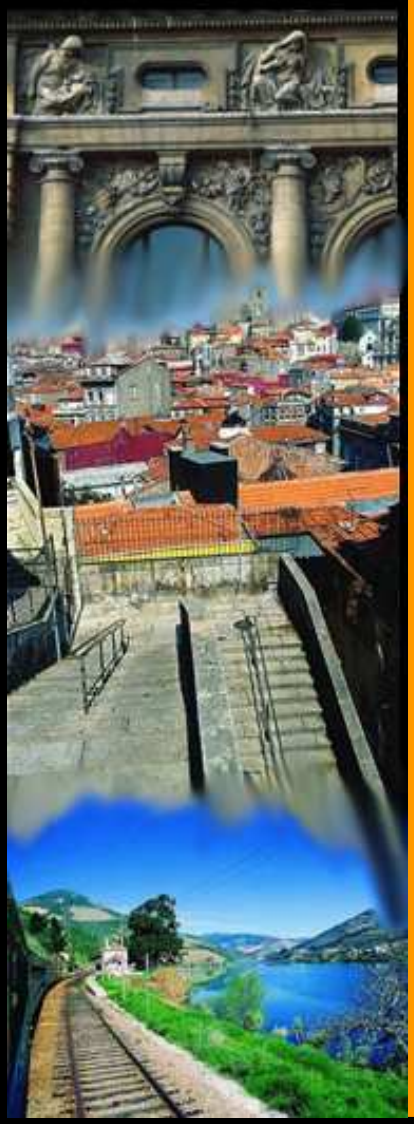
Jérémy Legardeur, Jorge Pinho de Sousa

european ideas for business erima

european research in innovation and management alliance

08'

erima



Towards new challenges for Innovative management practices

Volume 2 – N°1

Selected papers from ERIMA'08 proceedings: International Symposium on Innovative Management Practices

ERIMA Publication - www.erima.estia.fr

Editors:

Jérémy Legardeur — ***ESTIA - France***

&

Jorge Pinho de Sousa — ***INESC Porto - Portugal***

ESTIA ENGINEERING INSTITUTE CCI BAYONNE & BASQUE COUNTRY

REGION AQUITAINE

INESCPORTO

ISSN 2100-0778

http://www.erima.estia.fr

erima@estia.fr

Table of Contents

Preface

The global objective of ERIMA (European Research on Innovation and Management Alliance) is to constitute a "Network of European Excellence" in the field of Innovation and Industrial Management (I&IM). ERIMA is currently formed by 13 highly qualified Europeans Universities and Research Centres from 10 countries in Europe. The aim of this network is to promote new theories, methods, and techniques in I&IM issues.

This second edition of "Towards new challenges for innovative management practices" is resulting from the scientific and industrial contributions of ERIMA'08 Symposium. This conference was held in November 2008 in Porto, Portugal.

Once again in 2008, the ERIMA conference has gathered together researchers, business leaders of both SMEs and large companies, public sector representatives, and practitioners focused on innovation management. The objective of the conference was to provide an inspiring background and stimulus for a focused, target-oriented discussion regarding the new concepts in collaborative working environment, systematic innovation, and their respective management and support ICT tools and technologies.

The topics of ERIMA'08 were:

- Models, Tools and Methods for Innovation Management
- Fieldwork, Case studies and Storytelling of Innovative Management Practises
- Intra & Entrepreneurship initiatives
- Innovative services
- Creative routines, cultures and behaviours
- Education, learning and knowledge flows in practise
- Professional virtual and informal communities
- Collaborative environment
- Enterprise interoperability
- Combining economic social and environmental objectives
- Innovative sustainable public policies
- Innovative welfare development

Reference to the papers of this book should be made as follows: Initiale(s), Name(s), "Title of the paper", in the book "Towards new challenges for innovative management practices", Vol.2, n°1, pp. xx-xx, Editors: J. Legardeur, J. Pinho de Sousa, ERIMA Publication, 2008. ISSN 2100-0778

Example: F. Sousa, R. Pellissier, I. Monteiro, "Creativity and Problem Solving in the Development of Organizational Innovation", in the book "Towards new challenges for innovative management practices", Vol. 2, n°1, pp. 4-10, Editors: J.Legardeur, J. Pinho de Sousa, ERIMA Publication, 2008. ISSN 2100-0778

Jérémy Legardeur
Jorge Pinho de Sousa

ERIMA'08 Committee

General Co-chairs of the symposium

Legardeur Jérémy (ESTIA) France

Pinho De Sousa Jorge (INESC PORTO) Portugal

Scientific Advisory Board

Allen P. (Cranfield University) UK

Corallo A. (ISUFI) Italy

De Looze M. P (TNO) Netherlands

Dorronsoro I. (MCC) Spain

Kirner E. (Fraunhofer - ISI) Germany

Kongsvold K. (Sintef) Denmark

Larrasquet JM. (ESTIA) France

Legardeur J. (ESTIA) France

Lucas S. A. (INESC PORTO) Portugal

Martin J. (MIK) Spain

Merlo C. (ESTIA) France

North K. (Fachhochschule Wiesbaden) Germany

Pinho de Sousa J. (INESC PORTO) Portugal

Salkari I. (VTT) Finland

Unanumo A. (MIK) Spain

Thoben K. (BIBA) Germany

Wagner F. (IAO) Germany

Organization Committee

Reuter P. (Université Bordeaux 2) France

Savoie E. (ESTIA) France

Vilas Boas L (INESC PORTO) Portugal

Creativity and problem solving in the development of organizational innovation

F. Sousa[1*], R. Pellissier[2], I. Monteiro[3]

[1] President, Apgico, INUAF, Loulé, Portugal.

[2] Department of Business Management, University of South Africa.

[3] Board member, Apgico, University of Algarve, Faro, Portugal.

* Corresponding author: cardoso_sousa@hotmail.com, +351 918296843

Abstract: This research focuses on creativity and innovation management in organizations. We present a model of intervention that aims at establishing a culture of organizational innovation through the internal development of individual and team creativity focusing on problem solving. The model relies on management's commitment and in the organization's talented people (creative leaders and employees) as a result of their ability in defining a better organization. The design follows Min Basadur's problem solving approach consisting of *problem finding, fact finding, problem definition, solution finding and decision implementation.* These steps are carried out using specific techniques and procedures that will link creative people and management in order to initiate the process until problems are defined. For each defined problem, project teams will develop possible solutions and implement these decisions. Thus, a system of transformation of the individual and team creativity into organizational innovation can be established.

Keywords: Organizational creativity, Organizational innovation, Creative leadership, Creative problem solving, Kelly's Grid.

I- Organizational INNOVATION

Innovation within the framework of a knowledge-based economy goes far beyond the linear or chain linkage models that have long been used in innovation theory to explain innovation processes in high-tech industries (Strambach, 2002). Innovation is to be understood as the result of cumulative dynamic interaction and learning processes involving many stakeholders. Here innovation is seen as a social, spatially embedded, interactive learning process that cannot be understood independently of its institutional and cultural context (Cooke Heidenreich, & Braczyk, 2004; Lundvall, 1992; Freeman, 1998). Since Roberts' (1999) definition [of innovation] maintains that an innovation can only be seen as innovation if it is has implementation and commercial value, it is important to measure the impact of innovation. Ravichandran (2000: 263) believes that measuring the impact of innovation activities will depend on (1) the typology, (2) the degree of departure from the preceding product, service or process, (3) the extent of usefulness of the innovation and, (4) the volume of profitability generated.

Strambach (2002) suggests that the interdisciplinary view of innovation systems is concerned with understanding the general context of the generation, diffusion, adaptation and evaluation of new knowledge which determines innovativeness. It follows that the focus is on non-technical forms of innovation as defined above. Common characteristics of the different approaches to innovation identified by Edquist (1997) include (1) innovation and learning at the centre, (2) a holistic and evolutionary perspective, and (3) an emphasis on the role of institutions. The increasing interdependence of technological and organisational change is a significant feature of systems of innovation, which means that technological innovation and organisational innovation have become increasingly important. These are combined with more diverse knowledge requirements which include not only technical know-how, but also economic, organisational, and sociological knowledge and competencies. The second reason for the increased interest in non-technical innovations is associated with the connection between the organisational innovation and the corresponding learning capacity. The acceleration of change that is part of the globalisation process means that organisational learning processes are more and more important for creating and maintaining competitiveness.

Ultimately, whether innovation is successfully diffused, requires some absorptive capacity on the part of the target audience. Cohen & Levinthal (1990: 128) define absorptive capacity as '… the ability of a firm to recognise the value of new, external information, assimilate it and apply it to commercial ends.' The diffusion of the innovation is normally dependent upon the specific innovation typology, the innovation champions, the time element to successful diffusion and the absorptive capacity of the adopters. Schnepp, Bhambri, & Von Glinow (1999) define technology transfer as a process whereby the knowledge is passed from one entity to another. This process involves the dissemination of documentation describing the technology, the training (called software) to transmit the knowledge and the transfer of the equipment, components or raw materials (called hardware). Gee (2006) maintains that technology transfer is the application of technology to a new use or a new user. Thus, technology transfer links the existing technology base and the innovation process in order to increase productivity.
There is no doubt that innovation has become a core driver for growth, performance and valuation. Although there are no best practice solutions to seed and cultivate innovation, Barsh, Capozzi and Davidson (2008) identify three building blocks for innovation: (1) formally integrate innovation into the strategic management agenda (thus innovation is managed, tracked and measured as a core element of the organisation's growth); (2) Create conditions that allow dynamic innovation networks to emerge and flourish and (3) Take explicit steps to foster a culture of innovation by valuing ideas and collectively overseeing risk. This is complemented by taking the following steps to advance innovation: (1) Identify the type of innovation that can drive growth and strategic objectives; (2) Add innovation to the formal agenda at regular leadership meetings; (3) Set performance metrics and targets for innovation and (4) turn selected managers into innovation leaders.

In organizational innovation, the unit for innovation is the organization itself (Wolfe, 1994). Although the outcome of the innovation may be process, product or service, the innovation needs to be undertaken through the creative inputs of the individuals and/or the management. We will suggest a project approach.

II- Organizational CREATIVITY and INNOVATION

Even though authors such as Stein (1994), describe creativity as a *process that results in novelty which is accepted as useful, tenable, or satisfying by a significant group of others at some point in time* and innovation as *the intentional introduction and application within a role, group or organization of ideas, processes, products or procedures, new to the relevant unit of adoption, designed to significantly benefit the individual, the group, organization or wider society* (West and Farr, 1990), it remains difficult to separate the idea from its implementation, especially when we move from the individual level to team and organizational levels.
On the other hand, innovation concerns the processes of implementation, relying mainly on organizational communication and power and, as the product of that communication process, innovation appears connected to what is perceived as new and useful by someone other than its originator, or as the putting to use of an idea (Kanter, 1983), in the domains of production, adoption, implementation, diffusion, or commercialisation of creations (Kaufmann, 1993; Spence, 1994). Once again, the construct of creativity remains exclusive to the relation established between the creator and his product, where nor even originality and usefulness are important, but only the "trying to do better", connected to cognitive and emotional processes taking place at the individual level (Sousa, 2007)
Even if we relate creativity to problem definition, and innovation to decision implementation, this last step requires a series of problem definitions, in order to carry out a decision or an idea, thereby making it difficult to separate these concepts at an organizational level. In fact, when we move from the individual level to the team and organizational levels, creativity and innovation become more and more difficult to separate, so that we must agree with Basadur (1997), when he says there is no difference between organizational creativity and innovation. Therefore, the moment we move to other levels besides the individual, we will use these terms (creativity and innovation) as synonyms, in order to simplify the discussion, and we refer organizational creativity, in the intervention model, depicted in Figure 1, as a *system devoted to enhance creativity in organizations,* thus using the definition proposed by Basadur .

III- Creative problem solving using BASADUR'S SIMPLEX MODEL

From the Creative Problem Solving (CPS) approach, Basadur (1997, 1999, 2000) proposed a new model, the Simplex model. Basadur's Simplex is a cyclic process in three distinct phases and eight steps. In each step there is a moment for active divergence, when individuals or groups produce as many ideas or options they can find, in a supporting climate in which judgment is deferred to allow the perception of new relationships between facts. During the divergence moments everyone must make extended efforts to avoid stopping too early, before all possible options have been produced. During active convergence, the participants will select one or more options to carry on to the next step. One last skill will allow the process to go on systematically through its eight steps and three phases: it's called vertical deferral of judgment. This skill helps the participants to distinguish between unclear situations and well defined problems, and between defining a problem and solving a problem.

First phase – Problem definition.

The following steps are involved:

1. *Problem finding*
   This step consists in identifying problems and opportunities for change or improvement within or outside the organization. In the first moment of active divergence, judgment deferral is required and sustained until the participants feel they cannot collect more relevant problems or changes opportunities. It is then time for active converge, selecting the problems that will deserve further exploration.

2. *Fact finding*
   Begins with a divergence moment, when the group defers judgment in order to gather as many information as possible on the selected problem, always accepting all the data that is produced. When there is a perception that all useful or possible facts have been collected, the group can converge and select a few facts that are considered to deserve further expansion.

3. *Problem definition*
   In this step the group will reformulate the facts selected into creative opportunities or challenges. Then the more promising problem will be selected to carry on to the next step. For Basadur et al. (1994) this is a crucial step and skilled participants will really help the process by asking the right questions that will be answered further on. In this step they elaborate maps reframing the problems using the question "How might we…", considered the most important question in the Simplex process. Another question will help to deepen the problem: "What is blocking…", "What is stopping.." or "why". The challenge mapping process helps to see the hierarchy or problems and the relations between them, clarifying the big picture.

Second phase – Problem solving.

The following steps are involved:

4. *Generating potential solutions*
   This step requires the participants to actively create as many potential solutions as possible to solve the selected problems or challenges. Divergence moment allows creating the most radical and apparently impossible solutions. In the convergence moment, some of them will be selected for evaluation.

5. *Evaluating potential solutions*
   Here it is required to generate as many criteria as possible to help evaluating the potential of each solution that has been developed in the previous step. Having established the criteria, participants will evaluate the potential solutions against each criterion and decide which should be implemented.

Third phase – Solution implementation.

The following steps are involved:

6. *Action planning*
   Divergence skills are required to generate a number of specific actions that may help the implementation of solutions generated previously. Then convergence skills will allow selecting the most adequate actions.

7. *Gaining acceptance*
   This step aims at overcoming resistance to change and involve people needed in the process to assure its feasibility. This is directed essentially to people who did not participate in the earlier steps, but whose commitment is indispensable to bring the project to success.

8. *Taking action*
   Taking action is not the final step of the model, assumed as a circular process. As Basadur (2000) mentions, the organizational level is a continuous flow of products, services and processes that foster a better interaction with the environment. In this step, participants may find reasons not to fully implement the project, as a result of fear of failure and of resistance to change. To undermine these problems the author adopts Lakein (1973) techniques that advise to start with simple, specific and realistic actions, to address the fear of unknown by analyzing what could happen and then generating ideas to cope with fear of failure, trying to turn it into advantages.

IV- Proposed model of organizational innovation using creative problem solving

After an initial organizational investigation of all information and the problems the organization faces (*problem finding*) using interviews with management (the *formal approach*), an understanding of how it works from the point of view of its employees (the *informal approach*) is required. As it is not feasible to ask each individual, this can be made by identifying the implicit theories (ideas and concepts) people use to describe the organization (*fact finding*). In fact, most research in an organizational context has to deal with people who often speak in one way, but act differently. As Argyris (1999) reports, *espoused theories* (i.e., values and objectives that people declare as guiding their behaviour) differ from *theories in use* (the latter which really guide behaviour). Using Kelly's repertory grid method (Kelly, 1963) to design a questionnaire it becomes easier to use theories and overcome the espoused ones.
In his theory of personal constructs, Kelly stated that people anticipate events and that their behaviour is thus guided by this interpretation. Kelly's method allows people to vocalize their perceptions (sometimes in a way they have never verbalized before). Through a structured interview, this method allows us to design a questionnaire from the participant's viewpoint, thus reducing the observer's bias.
Using an organizationally adapted questionnaire, it becomes possible to spot weak and strong points in the organization. Although the questionnaire can address any organizational climate issue, it is preferable to ask people to describe their line managers in order to identify creative leaders and their teams, Nevertheless, other types of climate questionnaires (D'Amato & Burke, 2008) can be used and variables analysed, if some type of organizational evaluation has already been made.
Creative leaders, preferably designated by their teams, are interviewed and their perceptual maps identified in order to have a first approach to *problem identification*. Perceptual maps can be obtained through content analysis of the responses and then using factor analysis to categorise these (Sousa & Monteiro, 2005). Here, the innovative leaders are not the ones who have good or creative ideas, but those who develop the co-workers creativity and ability to innovate, in a definition quite consistent with Basadur's (2004) creative leadership conception. An innovative manager permanently seeks the continuous quality improvement and gets the co-workers to invest in the constant enhancement of the performance, which is the essence of innovation.

As can be seen from Figure 1, the 4th step consists of *managers and creative people teaming up*, where talented employees are identified and integrated into development teams together with other technicians in order to contribute to the project development. These teams receive creative problem solving training and list organizational problems from which management will select those that deserve to be subjected to the 'idea finding' step, until a decision is made and implemented in the last step (called *project implementation).* Creative people, either managers or employees, are committed to their work and organization, and so they may bring in important issues, provided that top management values their work and ideas. In fact, according to a Gallup Management Journal (GMJ) survey (Hartel et al., 2003) , engaged employees are more likely to "think outside of the box" and produce creative ideas than disengaged people; they also are more receptive to new ideas. The research concludes that engaged people tend to find and suggest new ways to improve their work and business processes, which may lead to the assumption that the more creative people have a deeper understanding of the organizational processes, being in a privileged position to identify, define and find the relevant organizational problems

The creative problem solving training (Isaksen, Dorval & Treffinger, 2000), is a cognitive training method for the development of critical and creative thinking abilities, represented in the mental skills of *data conceptualizing, analysis, synthesis and evaluation, as well as in the process of gathering information through direct observation, experimentation or reflection.* This further allows for the training of leadership and team work skills. This methodology uses a series of tools and structures with ill defined problems, the latter of which do not have a single possible solution, or problems that have not produced satisfactory solutions using other problem-solving methods. It includes the steps of *problem finding, fact finding, problem definition, solution finding and decision implementation*. Each of these steps has two moments: one divergent, in which the group tries to find the maximum possible number of alternatives; and another convergent, in which only one alternative (or just a few) is selected. The process continues until a system of organizational innovation is developed.

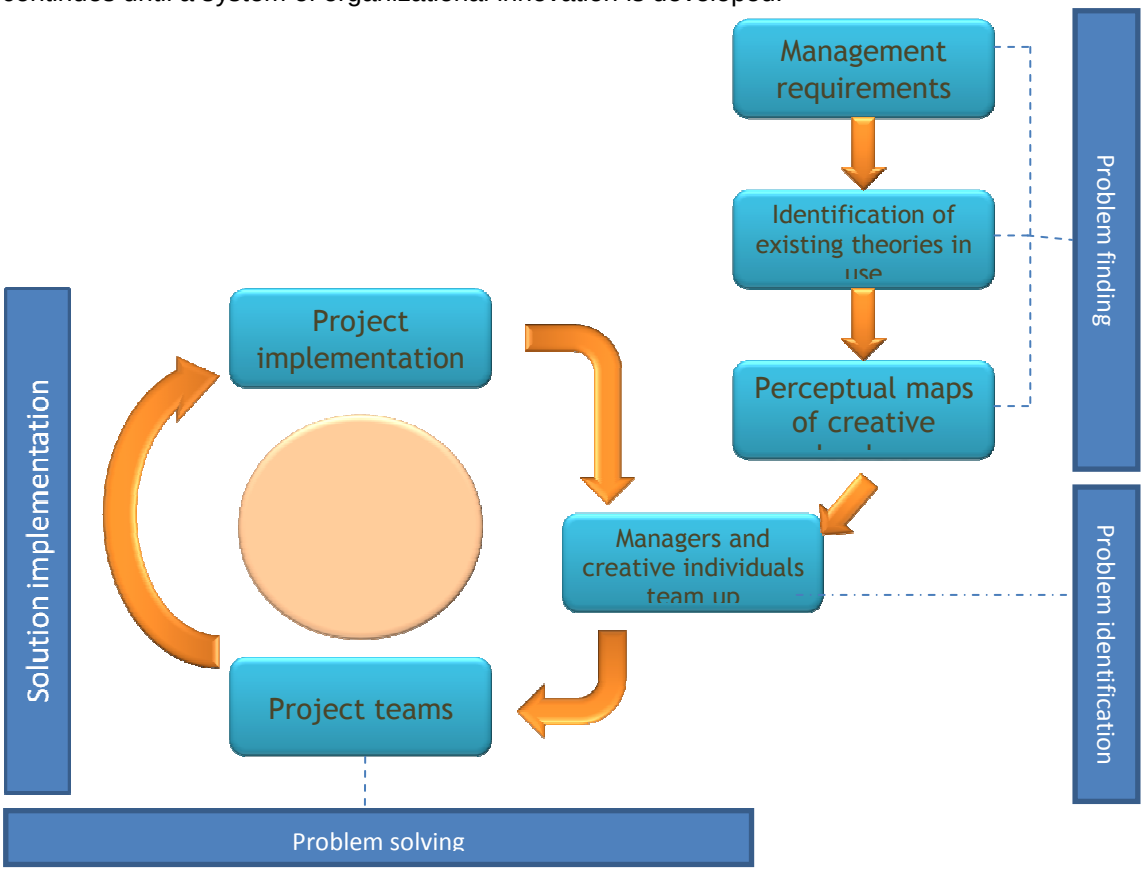


Figure 1: Proposed model of organizational innovation using creative problem solving

Other central aspects of organizational innovation (*management control measures, knowledge management, organizational communication and culture, and employee commitment*) will be

addressed in this cycle, for instance the outcomes of the change process that will establish (if successful), a different culture in the organization, allowing for a shared thinking process that will facilitate knowledge management and the fit between the organization and its changing environment (Basadur & Gelade, 2006).
If successful, the model will allow for the creation of a culture of innovation within the organization, committing more and more of its constituents, as more development projects become profitable innovations (Basadur & Paton, 1993; Isaksen et al., 2000).

V- Conclusion

This model of organizational creativity has proved to give useful contributions to organizational innovation, in the steps before solution implementation, due to the research and applications made (Sousa & Monteiro, 2005; Sousa, 2007). As the creative problem solving tools have already demonstrated their usefulness in finding solutions and helping organizations to improve, what remains to be proved is the value of selecting and organizing creative people in an organization, by giving them time, space, knowledge and the opportunity to team up and direct their individual creativity to the organizational problems. The process of developing organizational innovation and creativity is complex and non-linear with ups and downs, which can only give rise to a culture of innovation with the management's total commitment. Future research will allow for testing of the model, in its wide complexity, and will provide new insights into the process of organizational creativity and innovation.

Acknowledgement

We would like to thank our industrial partner E. Azevedo, for the field testing of the initial steps of this model, in order to make it feasible.

References

Argyris, C. (1999) *On organizational learning*. Oxford: Blackwell Publishers

Barsh, J, Capozzi, M.M . & Davidson, J. (2008) Leadership and Innovation. *McKinsey Quarterly,* 2008, No 1, p 37-47.

Basadur, M. & Gelade, G. (2006). The role of knowledge management in the innovation process. *Creativity and Innovation Management, 15*, 1, 45-61

Basadur, M. & Paton, B. (1993) Using creativity to boost profits in recessionary times. *Business Strategies*, Jan-Feb., 14-19.

Basadur, M. (1997). Organizational development interventions for enhancing creativity in the workplace. *The Journal of Creative Behavior, 31*, 1, 59-73

Basadur, M. S. (1999) *Simplex: A flight to creativity*. The Creative Education Foundation

Basadur, M. S. (2000) *The economic, social and psychological outcomes of implementing a deliberate process of organizational creativity*. Working paper nº 100. Mc Master University, Management of Innovation and New Technology Research Center.

Basadur, M. S. (2004). Leading others to think innovatively together: Creative leadership. *Leadership Quarterly, 15*, 103-121.

Basadur, M. S., Ellsperman, S. J. & Evans, G.W. (1994). A new methodology for formulating ill-structured problems. *Omega International Journal of Management Science*, *22*, 6, 627-645

Cohen, W.M. & Levinthal, D.A. (1990) Absorptive capacity: A new perspective on learning and innovation. Administrative Science Quarterly, Vol 35, p 128-152.

Cooke, P., Heidenreich, M. & Braczyk, H.J. (2004) Regional Innovation Systems, London: Routledge.

D'Amato, A. & Burke, M. J. (2008). Psychological and organizational climate research: Contrasting perspectives and research traditions. *European Journal of Work and Organizational Psychology*, *17*, 1, 1-4

Edquist, C. (1997) Systems of Innovation: Technologies, Institutions and Organizations, London: Printer

Gee, S. (2006) Technology transfer, innovation and international competitiveness. New York: John Wiley.

Hartel, J., Schmidt, F. & Keyes, L. (2003) *Well-being in the workplace and its relationship with business outcomes: A review of the Gallup studies* (205-224). Washington D.C.: American Psychological Association

Isaksen, S., Dorval, K. & Treffinger, D. (2000) *Creative approaches to problem solving: A framework for change*. Buffalo, NY: The Creative Problem Solving Group

Kanter, Rossabeth M. (1983) *The change masters*. New York: Simon & Schuster.

Kaufman, G. (1993) The logical structure of creativity concepts: A conceptual argument for creativity as a coherent discipline. In S. G. Isaksen, M. Murdock, R. Firestein & D. Treffinger (Eds.) *Understanding and recognizing creativity: The emergence of a discipline* (141 - 158). Norwood, NJ: Ablex Publishing Corporation.

Kelly, G. (1963) *A theory of personality. The psychology of personal constructs*. New York: Norton & Company

Lakein, A. (1973). *How to get control of your time and your life*. New York: Peter W. Wyden, Inc.

Lundvall, B.A. (1992) National Systems of Innovation: Towards a Theory of Innovation and Interactive Learning,. London: Printer.

Ravichandran, T. (2000) Redefining organizational innovation: Towards theoretical advancements. *The Journal of High Technology Management Research,* Vol 10, no, p 243-274, Elsevier Science Inc.

Roberts, E. (1999) Managing invention and innovation. *IEEE Engineering Management Review*, Vol 17. p 3-13.

Schnepp, O., Bhambri, A & Von Glinow, M. (1999) US-China technology transfer*:* Problems and solutions*.* Paper presented at the US-China Symposium Woodrow-Wilson Center, Washington DC, April.

Sousa, F. & Monteiro, I. (2005) Aplicações das grades de Kelly às representações sociais do professor criativo [The use of Kelly's grids in the social representations of the creative teacher]. In Moreira, A., Camargo, B., Jesuino, J. e Nóbrega, S. (Eds.). *Perspectivas teórico-metodológicas em representações sociais* [*Theoretical and methodologial perspectives in social representations*]. João Pessoa, PA: Editora Universitária UFPB

Sousa, F. (2007) Teachers' Creativity and Effectiveness in Higher Education: Perceptions of Students and Faculty. *The Quality in Higher Education*, *4*, 21-38

Spence, W. R. (1994*) Innovation: The communication of change in ideas, practices and products*. London: Chapman & Hall.

Stein, M. I. (1994) *Stimulating creativity* (Vol. I). New York: The Mews Press, Ltd. (Originally published in 1974, by Academic Press)

Strambach, S. (2002) Change in the innovation process: New knowledge production and competitive cities - The case of Stuttgart. European planning studies*,* vol. 10, no. 2, 2002, p 215-231.

West, M. A. & Farr, J. L. (1990)*.* Innovation at work. In M. A. West & J.L. Farr (Eds.), *Innovation and creativity at work: Psychological and organizational strategies* (3-15). Chichester: Wiley & Sons.

New collaborative BTO process in automotive production

S. Ost[1*], J. Mandel[2]

[1] Fraunhofer Institute for Manufacturing Engineering and Automation, Stuttgart, Germany

[2] Fraunhofer Institute for Manufacturing Engineering and Automation, Stuttgart, Germany

* Corresponding author: stefanie.ost@fraunhofer.ipa.de, +49.711.970.1954

Abstract: Today, the automotive industry is operating, in common with other manufacturing industries, in turbulent environments, mainly caused by changing customer purchase behaviour, increased international competition, overcapacities and decreasing margins. These developments affect the industry in two ways. Firstly, customers demand vehicles that are built to individual specifications. This has resulted in a dramatic products and parts variants proliferation and has subsequently led to an increase in operations and logistics costs. Secondly, delivery time has become a competitive factor to the OEMs. Both, researchers and practitioners state that the automotive industry's demanding customers no longer accept long delivery times. Therefore, they have discussed build-to-order (BTO) as a new concept to cope with the new challenges. BTO refers to a demand-driven production approach where a product is scheduled and built in response to a confirmed order received for it from a final customer. Only parts beyond a defined decoupling point are produced based on forecasts. In such a manufacturing network the whole supply chain must be flexible enough to adjust to short-term demand fluctuations without loosing economies of scale. Today, the flexibility of a manufacturing system is mainly restricted by inflexible product structures, labour conditions and subsequently inflexible supply chains.

Keywords: production network, collaborative management system, build-to-order (BTO), flexibility, collaborative processes, supply chain planning, automotive industry

I- Introduction: Initial situation in the automotive industry

Similar to other industries, the automotive industry has been experiencing fundamental changes in market requirements, technologies and customer purchase behaviour in the last years. Academics argue in this context that the markets have changed from "push markets" to "pull markets" and consider the key drivers for this shift are economic, social and technological developments. As a result of this shift and based on other related microeconomic and macroeconomic factors such as industry maturation, worldwide overcapacity and globalisation, new competitive factors emerged. The automotive industry, in particular, is facing two major challenges. Firstly, customers are demanding more and more vehicles built to their individual specifications. However, with respect to the high number of possible combinations of options and equipments, it is impossible to forecast the exact features of demanded cars in advance. Secondly, delivery time has become a competitive factor to vehicle manufacturers. Rich and Hines contend that in industries characterised by overcapacity and intense international competition, time becomes a further source of competitive advantage (Rich and Hines 1997). Both, researchers and practitioners state that the automotive industry's ever-demanding customers no longer accept long delivery times.

Under these circumstances, the traditional forecast-based mass production system of the automotive industry does not fit the new market requirements and cannot meet sophisticated customer needs any longer. As a result, the whole industry is suffering from excess inventories of cars that customers do not want, while being unable to deliver custom-built cars within a short and reliable delivery lead time. Build-to-order (BTO)/Assemble-to-order (ATO) has been considered as a new concept to cope with these new challenges, and as a source of competitive advantage. The idea behind this concept is to assemble the vehicles just after the final customer order has been generated. Yet, the potential of such a concept has also been recognised by the industry. Most of the vehicle manufacturers have meanwhile implemented internal projects focusing on the development of company-specific BTO concepts to provide customers with exactly the cars they want within a short and fixed order-to-delivery (OTD) lead time. Examples include the majority of the Original Equipment Manufacturer (OEM) of the automotive industry. However, all of these projects are still in their initial phases and no

manufacturer has a pure BTO system in place. Furthermore, the developed BTO concepts are mainly company specific and do not involve the corresponding production network.

Implementing a BTO concept in the automotive industry is not trivial, as cars are highly complex products which are built in networks consisting of various suppliers, logistics service providers and final assembly plants. Today, the flexibility of a production network is mainly restricted by inflexible product structures, inflexible labour conditions and the lack of seamless processes as well as information and communication technology (ICT) systems. Fine argues that a BTO environment requires a three-dimensional concurrent engineering effort where product structure, processes and supply chain all have to be taken into consideration (Fine 2000). The goal of this synchronisation is to provide customers with exactly the products they want in short order-to-delivery (OTD) lead times at minimum costs without loosing economy of scale.

In this context the supporting ICT systems, and in particular the order management and scheduling systems, play a crucial role. This paper provides a generic concept for new collaborative BTO-processes in production networks of the automotive industry based on the results of the EU research project "Intelligent Logistics for Innovative Product Technologies" (ILIPT). The goal of this project is to develop product-related, network-related and logistics concepts for a pure BTO manufacturing system for short OTD lead times of a minimum of five days.

II- Current ICT systems as a barrier for a pure BTO manufacturing system

Academics identified today's isolated ICT systems as one of the main barriers to reducing OTD lead times and implementing BTO concepts successfully. Howard et al. argue in this context that today's legacy systems were originally built for a 'different world' of IT capability and specific tasks, where technology was associated with 'control' (Howard 2001). They were once developed based on the functional and departmental orientation of companies and are hence still driven by in-bound logistics and pushed by production rather than by order demand. The results of the analyses, conducted in the UK 3DayCar Programme, revealed that in Europe there are five to seven different ICT systems implemented in the automotive supply chains starting at the dealers up to the 1st tier suppliers for order management, order submission, order scheduling, sequencing, supply planning and supplier scheduling (figure 1).

In some cases there are automated interfaces between these systems where the data and information is forwarded up the supply chain by means of batch runs once a day. However, these batch runs also delay the information flow. In cases where no automated interfaces are implemented, redundancy in data capturing is caused. This leads to longer lead times and delays the information flow, too. Consequently, more than 75% of total OTD lead time, i.e. on average 33 days, are spent on scheduling and order management.

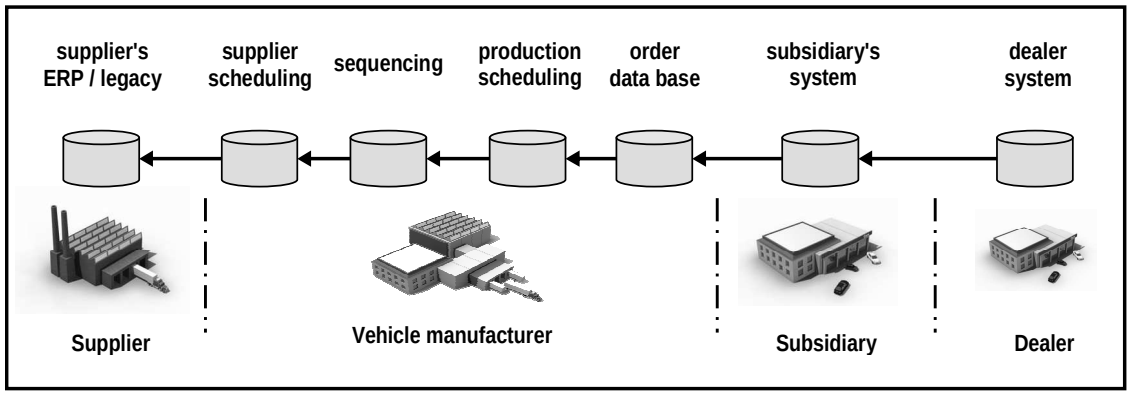


Figure 1. The customer order passes various ICT systems along the supply chain

In a pure BTO environment, the order management process is no longer triggered by forecasts but only by customer orders. Holweg and Pil emphasise on linking customer requirements

directly to production, so that the decisions are based on real customer demand rather than on forecasts (Holweg and Pil 2001). Moreover, the customer specifications have to be linked to the relevant manufacturing and supply processes. Standardised and seamless processes which connect the dealers, final assembly plants and relevant suppliers eliminate the unnecessary times and artificial delays in the scheduling process. Realising such a concept requires a spatially distributed system, which captures, processes and schedules orders for both, vehicle manufacturers and BTO suppliers, while taking all relevant capacity and product information into account.

III- The role of the decoupling point in a pure BTO manufacturing system

In order to allow all cars to be produced only based on final customer orders within a short OTD lead time, new technological innovations will be needed to support real time communication and computation. Systems must be able to interact without downloading or uploading activities, and without overnight batch processing, resulting in a seamless information and communication flow between the partners of the value chain. As network partners dealers, final assembly plants, 1st tier BTO and build-to-stock (BTS) suppliers (1st step before final assembly) and 2nd tier BTO and BTS suppliers (2nd step before final assembly) can be defined. Within this network the order decoupling point (DP) determines which partner needs what information at what time. The DP will be one of the most essential strategic variables within the future automotive industry representing the interface between those stakeholders which manufacture all products on a build-to-order basis and those that produce on build-to-stock principles (figure 2). As described by Parry and Graves the DP represents the last buffer in the supply chain where parts are stored that do not belong to a specific order (Parry and Graves 2008). The position of the decoupling point varies between different types of supply chains. It depends on production technology, production lead time for the components, degree of modularisation of the product, product type and structure, the distance between buyer and supplier as well as the OEM's postponement strategy and the delivery lead time demanded by the customer.

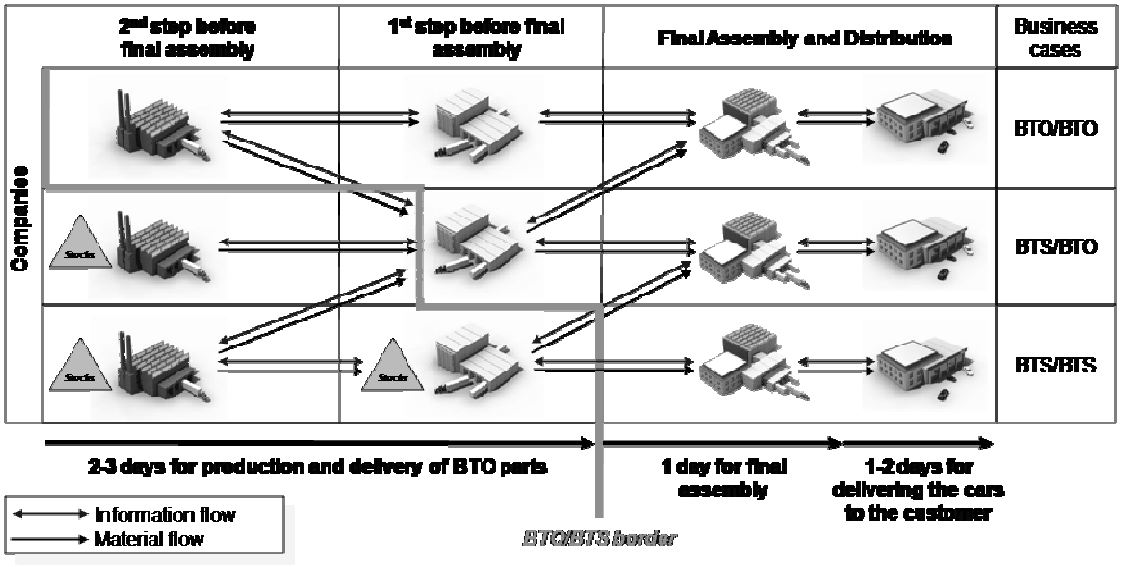


Figure 2. The two sections of a customer driven network

Based on the BTO/BTS border three different business cases can be identified which describe the relationship between the stakeholders of the network:

- BTO/BTO scenario
- BTS/BTO scenario
- BTS/BTS scenario

Within these defined scenarios the overall production, configuration and delivery for all build-to-order and build-to-stock parts take no longer than 2-3 days. The final assembly of cars can be realized within one day as it is already standard in today's automotive production. Assuming an optimized allocation of final assembly plants and dealers the delivery of cars to the final customer takes no longer than 1-2 days throughout Europe.

The BTO/BTO scenario is characterized by a stockless production and a radical reduction of lead times at the 1st and 2nd tier suppliers. It describes a highly specific product with high number of variants. In this business case high demand fluctuations can occur due to the dependence of the production volumes on real market demand. This leads to a 1:1 relationship between BTO parts and final customer orders.

The BTS/BTO scenario is characterized by a stockless production at 1st tier suppliers triggered by individual customer orders and vendor managed inventory at 2nd tier suppliers. BTS refers to products that are built before a final customer has been identified, with production volume driven by historical demand information. Producing on stock in a pure BTO system is needed for parts that have a longer lead time than the planned 2-3 days.

The BTS/BTS scenario indicates a vendor managed inventory at 1st and 2nd tier suppliers. Products with a low number of variants like electronic components are typical for such a scenario.

IV- Flexibility as a key requirement for a pure BTO production system

A key aspect to achieve the target of a pure BTO production network is the improvement of flexibility in all areas, i.e. with respect to product structure, processes, supporting ICT systems as well as production and logistics networks. In this case, the whole supply chain needs to be synchronised based on the final customer order so that all stakeholders are able to adjust their capacities and operations to short-term market demand without losing economy of scale.

Ensuring coverage against unused or inefficiently utilised capacities is a prerequisite of every competitive company and especially of a BTO aligned network. This can be enabled for instance by flexible working time. That means that employees do not get a weekly working time anymore but an annual working time budget. Their daily working time will then vary according to the demand. A bonus for the "additional hours" they work in times of high demand will not be paid. This model of flexible working times allows companies to better adjust their capacities to sudden market fluctuations and to increase the plant flexibility (Holweg and Pil 2001). Also, this concept enables the companies to have a range of minimum and maximum capacity and makes one of the main restrictions, namely capacity more "elastic" (figure 3). Unfortunately this model is not always applicable for companies with a 3-shifts-per-day-model.

When developing a pure BTO production network which is characterized by flexible processes different customer order types have to be defined. These order types differ in number of cars that are offered and the available time between the customer order and the required delivery date.

Customer Orders (short-term and long-term) are orders that are issued by a single end customer. These orders make up the largest share of the overall demand volume. As short-term order the customer issues his order short before the desired delivery date. Thus, the earliest and latest production dates are the same for this type of standard customer order.
Long-term orders differ from the short-term orders by having an earlier fixation point for the ordered configuration. This fixation period is at least 2 weeks before delivery. Therefore, fixed long-term orders can be produced in advance in order to smooth capacity demand peaks or gaps. Consequently, long-term orders have an earliest production date and a latest production date.

Fleet orders differ in quantity from a single car to orders up to several hundred cars. Today, most of the vehicle manufacturers use these orders such as of rental car companies, taxi companies, police, etc. as a base for the planning of their production volumes. These orders are usually issued several weeks up to several months before delivery. Hence, fleet orders can usually be produced well in advance in order to smooth capacity demand peaks or gaps. Furthermore, the production of the cars of a fleet order can be split amongst several final assembly plants. In order to increase the capacity flexibility in a BTO production network customer orders are scheduled prior to fleet orders. Fleet orders serve as flexible orders to utilise the remaining unused capacity.

Volume flexibility is given, when it is possible to produce many different products and variants on the same production line. Also, the use of external assembly service provider (EASP) give a considerable degree of volume flexibility since it reduces the necessary maximum capacity to be installed at the final assembly plant (FAP). EASPs can offer additional capacities to several FAPs simultaneously. The FAPs will only set up production and assembly facilities as well as capacities to cover a defined range (e.g. 75%-90%) of their forecasted demand. The remaining required capacity will be provided by EASP. This enables FAPs to run their facilities at a higher overall utilization level. By sharing their capacities for different OEM's, the EASPs can optimize their utilization and flatten the market demand fluctuations for different brands (Schulz 2004).

This concept requires close partnerships between the OEMs and EASPs. Especially in the early production phase the OEM has to train EASPs regarding assembly processes and the related quality issues to ensure that the vehicles assembled externally correspond to the OEMs quality standards. The EASP can either operate its own assembly plants or shared assembly plants of cooperating OEMs.

Furthermore, the realisation of such a concept requires increased standardisation of parts and components as well as in ICT systems to reduce the complexity and handling various brands and customers in the same plant. Introduction of cross-brand platforms is a further key pre-requisite for the extension of this concept and allowing assembly of various models and brands in the same plant.

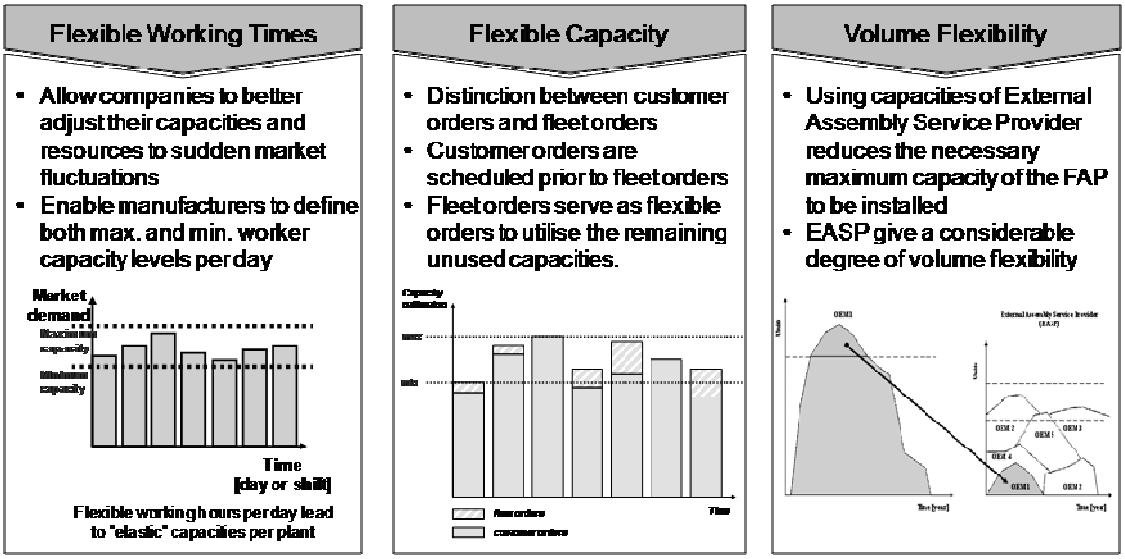


Figure 3. Flexibility as the key requirement for a successful BTO manufacturing system

V- Collaborative order management system for a pure BTO production system

Research has shown that most of the time is lost between order entry and scheduling vehicles to the appropriate final assembly lines. Very often, this takes days and weeks. A new order management system must be able to directly process the vehicle orders entered by the dealer or, in the future, by the customer itself, to assign them to suitable plants and feed them into a spatially distributed system. This system, which substantially reduces the information flow times, is called „Virtual Order Bank“ by the ILIPT consortium, or abbreviated to VOB, representing the central unit of the new order management system.

Since the VOB is not able to accept orders in unlimited numbers, it is necessary to first define the capacity data of the final assembly plants and all BTO suppliers and have them stored in the VOB. These capacity data do not refer to fixed values but to capacity margins indicating minima and maxima, which are adapted for each product every six weeks. Based on these margins in the supply chain, the capacity buckets of the final assembly plants are defined on a daily basis before being booked for the orders arriving in the VOB. Apart from directly booking the capacity buckets, the network also buffers fluctuations in demand, making it more flexible.

Moreover, it is essential that such a system allows for a multi-level bill-of-material (BOM) explosion for all BTO modules and all critical components across several stages of the supply chain, forming the basis for a multi-level order management system (figure 4). This system not only includes the entry, storage and continuous monitoring of orders, but also additional functions such as the due date determination (ATP), capacity management, plant selection and the creation of assembly and delivery schedules.

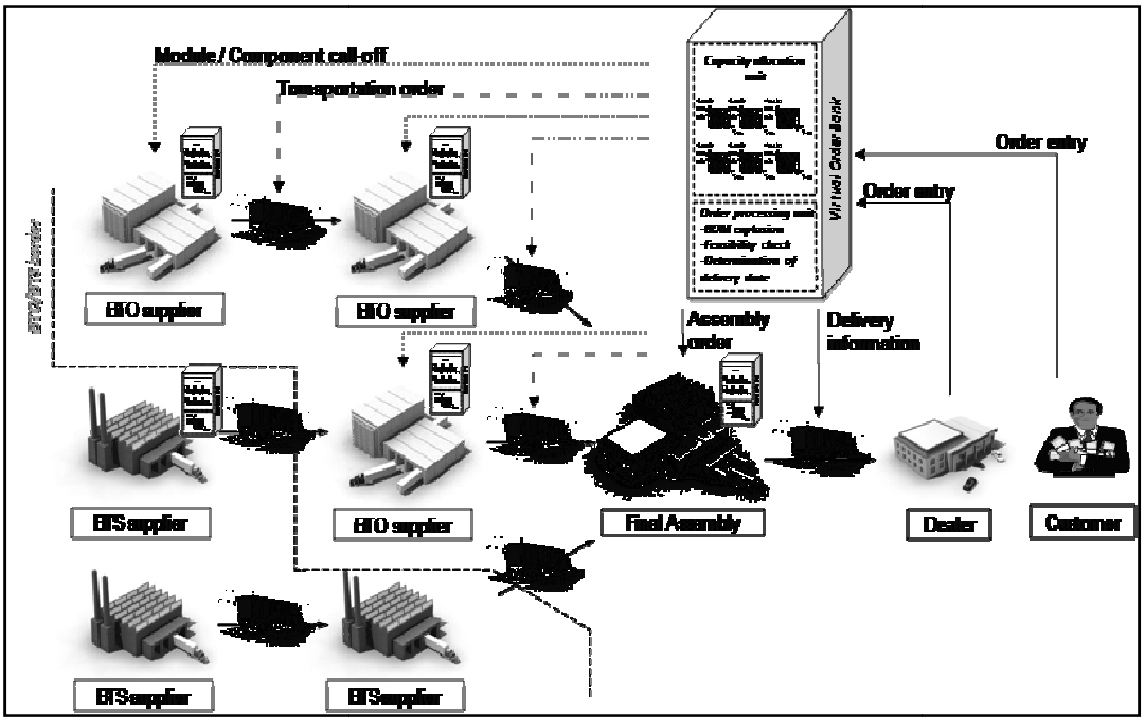


Figure 4. Order entry and call off until the decoupling point

If the capacity buckets have been defined and an integrated Available-To-Promise (ATP) component is being installed the due date determination function in the VOB can calculate a reliable delivery date. The task of the capacity management function is to determine the capacity requirements and match them with the capacity available at the relevant companies across multiple levels of the supply chain. In selecting the plants, the VOB considers relevant criteria such as costs, capacity and distance to final customer before choosing the appropriate assembly plant for each individual customer order. Finally, daily assembly schedules for each plant and delivery schedules for the BTO suppliers are created.

During the whole process the concerned stakeholders have to be able to monitor the order situation in real-time in order to increase their transparency for future orders. This makes them more flexible and gives them more time to optimise their processes. However, due to security issues each partner should only get access to the information they really need e.g. agreements on capacity and stock levels. Nevertheless, for a seamless information flow the VOB has to be linked to all relevant ICT systems of the stakeholders such as ERP systems and to all other VOBs in the value chain. Furthermore, the relevant data such as capacity has to be updated continuously in each VOB.

VI- Epilogue

The today's mass production system cannot meet the new dynamic market requirements any longer. BTO is an interesting alternative solution to the old mass production concept. However, because of the high product complexity in this sector, the successful implementation of a BTO manufacturing system requires a radical SCM approach. The legacy systems form of the today's vehicle manufacturers cannot provide the requirements of a pure BTO manufacturing environment. They were originally developed to support the requirements of specific departments in functional oriented companies of the past. In pure BTO manufacturing system synchronisation of the supply chain is the most important fact for short OTD lead time. Orders from the final customer have to be linked directly with the assembly planning and supplier scheduling without any time delay and distortion by means of an inter-enterprise order management system, which is referred to as VOB. The vehicle manufacturer as the focal company has to synchronise the assembly operations together with supply and distribution logistics. In order to meet all requirements of a pure BTO manufacturing environment, the VOB has to provide five main functionalities: Firstly, management of customer orders, encompassing order capturing, order storage, multi-tier BOM explosion for critical parts, components or modules, as well as ongoing order status monitoring; secondly, delivery date calculation; thirdly, capacity management including demand-capacity checking, as well as capacity allocation to specific customer orders at various tiers of the supply chain; fourthly, selection of suitable assembly sites by taking all relevant constraints and costs into account; finally, generation of assembly and production orders for the assembly sites and BTO suppliers concerned.

Nevertheless, implementing a pure BTO production system throughout the whole supply chain offers the following advantages:

- Higher customer satisfaction by providing the customers only with the products they want at reasonable costs
- Higher customer satisfaction and loyalty by providing short order-to-delivery lead times and a great adherence to delivery dates
- Provide customers with a great choice of product variants at high quality
- Avoid costly stocks at the most expensive point of the supply chain
- Increase margins for vehicle manufacturers, suppliers and logistics service providers
- Realization of even capacity utilizations within a defined range

Klimmek stated that cost advantages of build-to-order mainly result from reduced or eliminated inventory, lower effort for forecasting, and abdication of supplementary customization efforts (Klimmek 2005). Also, customer satisfaction is much higher since build-to-order allows for a best match of customer needs, i.e. the customer receives an individual product at the right time. Therefore, build-to-order as business model for the European automotive industry helps to gain a competitive advantage from faster delivery, better prices and high customization. Also, this approach reconnects the customer to the value chain.

The pure BTO approach links production and demand to the actual market demand. This makes the system more vulnerable to changes in market demand and fluctuations. Therefore, flexibility

in product structures, processes, supporting ICT systems as well as production and logistics will be the key to a pure BTO production network.

References

Brown, S. Lamming, R., Bessant, J. and Jones, P., 2002: Strategic Operations Management: Butterworth-Heinemann: ISBN 0 7506 4257 2.

Fine, C., 2000: Clockspeed-based strategies for supply chain design: Production and Operations Management: 9**/**3: 213-221.

Griffiths, J., Margetts, D., 2000: Variation in production schedules – Implications for both the company and its suppliers: Journal of Materials Processing Technology: 103: 155-159.

Hart, C.W., 1996: Made to order: Marketing Management: 5/2: 10-23.

Holweg, M., Miemczyk, J., 2002: Logistics in the 'three day car' age: International Journal of Physical Distribution and Logistics Management: 32/7: 829-850.

Holweg, M., Pil, F.K., 2001: Successful build-to-order strategies: Start with the customer: MIT Sloan Management Review: Autumn: 74-83.

Holweg, M., Pil, F.K., 2004: The Second Century – Reconnecting Customers and Value Chain through Build-to-Order: The MIT Press: Massachusetts.

Howard, M., Vidgen, R., Powell, P., 2005: Automotive industry information systems – From a mass production to build-to-order: Journal of Cases on Information Technology: 7**/**2: 16-30.

Howard, M., Young, K., Graves, A., 2001: Towards the 3Daycar: Vehicle design and its impact on rapid build-to-order: International Journal of Vehicle Design: 26/5.

Klimmek R., Stratil P., Dickhoven K. 2005: Limits of Build-to-Order Processes in the light of changing business framework in the automotive industry: European Concurrent Engineering Conference 2005

Kotha, S, 1995: Mass customisation – Implementing the emerging paradigm for competitive advantage: Strategic Management Journal: 16: 21-42.

Kuhn A., Hellingrath B., 2002: Supply Chain Management - Optimierte Zusammenarbeit in der Wertschöpfungskette: Springer Verlag: Berlin.

Nayabi, K., Baumgaertel, H., Hellingrath, B., Holweg, M., Bischoff, J., 2006: Automotive SCM in einem vollständigen Build-to-Order-System: Supply Chain Management: I/2006: 7-15.

Parry G., Graves A. 2008: Build to Order: The road to the 5-Day Car: Springer: 177-254.

Pine, B.J., 1993: Mass customization*:* The new frontier in business competition: Harvard Business School Press: Boston.

Renner, P., Ciesielski, K., 2000: Customer-oriented sales and production process (KOVP): Society of Automotive Engineers: BMW Group: Germany: Munich.

Rich, N., Hines, P., 1997: Supply Chain Management and Time-Based Competition: The Role of the Supplier Association: International Journal of Physical Distribution and Logistics Management: 27: 3/4: 210-225.

Schulz, W.-D. (2004): Leben von der Modellvielfalt, Presentation Slides, 6. Internationales Automobil-Forum Graz, 19-21/Oct/2004

Sharma, A., LaPlaca, P. 2005: Marketing in the emerging era of build-to-order manufacturing: Industrial Marketing Management: 34**/**5: 476-486.

Investigating Innovation techniques for the Greek SMEs within the European Union

C.P. Kitsos[1,*], Y. Hatzikian[1]

[1] Technological Educational Institute of Athens, Athens, Greece

* Corresponding author: xkitsos@teiath.gr, +302105385308

Abstract: In the context of this paper we examine if and in which degree the innovation management techniques are used by the Greek enterprises in comparison to E.U. From the economy of knowledge, theory and statistical data analysis, the innovation does not constitute an individual activity of enterprise. On the contrary the new technologies influence the total of operations and the organisation. The analysis is based on the conceptual frame that developed by the EUROSTAT and the OECD (Handbooks Oslo and Frascati) and on the empirical data of CIS 2, 3, 4. Also, we adopted the empirical data of research work entitled : "Woman and Innovation: The determinants factors and the obstacles of innovative activities in the Greek enterprises: 2000-2003, TEI of Athens" funded by 75% by E.U.

Keywords: Innovation, Organizational Innovation, Knowledge Economy, National System of Innovation.

I- Introduction

In the context of the present work, we examine the innovative activities of the Greek enterprises, operating in industry and services sectors, with respect to the "non-technical" aspects of innovation, such as management techniques, organisational change, design and marketing issues, at time interval 1998 until 2000. We examine if and in which degree the innovation management techniques are used by the Greek enterprises. As an example consider the not technological innovations, that according to the Oslo Manual, include organisational or commercial nature innovations. The innovative performance of the Greek firms is compared to European Union one, in order to identify similarities and differences. In the economy of knowledge (OECD 2001), theory and statistical data, point out, that innovation does not constitute an individual activity of enterprise. On the contrary the new technologies influence the total of operations and the organization (Kitsos et. al. 2006, Kitsos and Hatzikian 2006). In the knowledge-based economy (European Commission 2004), innovation has obtain the central role in the business world achievements. In addition to traditional technological innovation, there is innovation through new business models, new ways of organizing work, and innovation in design or marketing. Managing and exploiting to the best effect of all these different kinds of innovation represents a major challenge to businesses. Strategic and organizational changes applied in business should take into account the challenge of the new knowledge economy. Within the firms that actually implement strategic and organizational changes, the perspective involved is that strategic and organizational changes can help their firms to foster competitive advantages by increasing flexibility and efficiency. Therefore, there is a strong need for strategic and organizational changes in Greece in order the Greek firms to reach or to absorb the information and knowledge successfully.

II- Research background

We worked on the research project entitled : "Woman and Innovation: The determinants factors and the obstacles of innovative activities in the Greek enterprises: 2000-2003, TEI of Athens" funded by 75% by European Union and 25% from the Greek Ministry of Education .The analysis is based on the empirical research and, also, on the empirical data of Community Innovation Survey. As to the conceptual frame, the analysis is based on that developed by the EUROSTAT and the OECD (OECD 2005, OECD 1993).

Innovation management is a discipline and it involves focusing on the organization's mission, searching for unique opportunities, determining whether they fit the organization's strategic direction, defining the measures for success. Innovation process is characterized by an inherent uncertainty. In comparison to traditional mechanistic command and control management, these characteristics entail a fundamental change in the strategic perception of the organization, which

accordingly has to consider the management challenges, such as to network with internal and external partners and to balance individual and corporate motivation. Knowledge-based innovation requires not a simple field of knowledge but many fields of knowledge. Furthermore, it requires the convergence of many different kinds of knowledge retained by a variety of actors. The systemic approach to innovation (Nelson 1993) recognises that innovation and knowledge generation take place as a result of a variety of activities, many of them outside the formal research process.

The increasing importance of knowledge is changing the way firms compete and the sources of comparative advantage between countries. It is a reality that the balance between knowledge and resources has shifted so far towards the former. Knowledge has become perhaps the most important factor determining the standard of living (World Bank 1998). If the organization is to stay responsive to external change, a flexible and adaptable organizational structure is a necessity. The conceptual frame developed by the EUROSTAT and the OECD (Handbooks Oslo and Frascati), is suitable in our investigation of the "non-technical" aspects of innovation and the degree the innovation management techniques are used by the firms, because it offers a sound taxonomy regarding the implementation of new or significantly changed corporate strategies, of advanced management techniques within your enterprise, of new or significantly changed organizational structures, of marketing innovation and of aesthetic appearance or design or other subjective changes in at least one of your products.

III- Empirical Approach to Innovation Indicators

In this section, we analyze the Greek innovating enterprises in the manufacturing and services sector in their efforts to develop innovating activities in comparison to the E.U. member states.

Table 1 indicates that the innovative manufacturing enterprises represent the 26,5% in the first period (1994-96), the 30,3% in the second period (1996-98), the 27,3% in the third period (1998-00) and the 35,1% in the fourth period (2002-04).

Table 1 : Innovation Indicators: Manufacturing enterprises : Greece

Indicators	1994-96*	1996-98*	1998-00**	2002-2004***
	% Share in population	% Share in population	% Share in population	% Share in population
Enterprises with innovation activity	26,50	30,30	27,3	35,1
• Product innovators	22,5	25,2	18,4	24,9
• Process innovators	18,5	23,7	17,5	30,9
• Intramural R&D	20,6	21,2	21,8	27,1(1)
Research and experimental development - R&D	15,8	18,9	17,3	na
• Continuous R&D	5,1	7,1	7,1	na
• Occasional R&D	10,7	11,8	na	na
Enterprises with Cooperation arrangements on innovation activities	4,7	6,5	5,1	20,6
Product innovators that introduced new or improved products to the market	10,4	14,0	10,3	15,6
Enterprises receiving public funding	11,4	10,9	17,0****	17,3

Sources : GSRT, 2004 (CIS 3), GSRT, 2004 (CIS 4), Eurostat

*>20 employees ; **> 10 employees ; ***Summary results, ****Central Government

Note : (1) Both sectors (manufacturing and services)

This provides evident that there is a small improvement for the Greek industry, as far as competitiveness concern. The innovation indexes are rather a new discipline in the Greek statistical system, when measuring industrial indexes. That is why only recent data can be provided and analyzed. We present the main figures we collected concerning the Greek industry, as far as innovation concerns. The statistical analysis of an analysis of innovation haw been extensively discussed by Kitsos et. al. (2006).
Product innovators represented the 22,5% in the first period, the 25,2% in the second period, the 18,4% in the third period and the 24,9% in the fourth period. Process innovators represented the 18,5% in the first period, the 23,7% in the second period, the 17,5% in the third period and the 24,9% in the fourth period. These figures might provide evidence on a contradiction to the above mentioned result. But when new or improved products are entering to the market the innovation indexes are relatively low: 10,4% in the first period, 14,0% in the second period, 10,3% in the third period and 15,6% in the fourth period. Only a small number of Greek private companies (we believe 16 in number!) are adopting innovation for products and processes successfully commercially and technically. The public funds have been increasead to improve innovation, without successful consequences, see Tables 1 and 2. This might be called as a "Greek paradox", and we would analyze more this elsewhere.
In Table 2 the share of innovative enterprises in the Greek service industry increased significantly from 11,1% in the first period to the 15,5% in the second period, the 31,9% in the third period and the 36,7% in the fourth period (2002-04) of the enterprises with 10 or more employees. That is service industry is performing much better than manufacturing industry.

Table 2 : Innovation Indicators : Service enterprises with 10 or more employees : Greece

Indicators	1994-96	1996-98	1998-00	2002-2004**
	% Share in population	% Share in population	% Share in population	% Share in population
Enterprises with innovation activity	11,1	15,50	31,9	**36,7**
• Intramural R&D	4,2	6,2	6,6	na
Research and experimental development - R&D	8,3	13,0	16,1	na
• Continuous R&D	5,6	5,6	10,5	na
• Occasional R&D	2,8	7,5	na	na
Enterprises with Cooperation arrangements on innovation activities	6,3	5,6	12,8	26,9
Enterprises receiving public funding	2,1	3,1	15,5*	12,5

Sources : GSRT, 2004 (CIS 3), GSRT, 2004 (CIS 4), Eurostat
*Central Government, **Summary results

The Greek industry performance in terms of the number of innovative manufacturing enterprises is almost at the same level with Spain (34,7%), Italy (36,3%) and Netheralnds (34,3%) performance concerning the period 2002-2004, see table 3. In contrary, for the same period, Greece is lagging behind comparing to Germany (65,1%), Austria (52,5%), Ireland (52,5%), (Denmark (52,0%), Belgium (51,3%) Sweden (50,0%), UK (43,0%) and Spanish (37,0%) performance.

Nevertheless, the gap with the other European countries remains significant. The average of European Union is at 44,0% for the period 1996-98 and 45,1% for the period 2002-2004. Germany holds the maximum percentage: 65,1% and France the minimum one (32,5%) for the period 2002-2004.

Table 3 : Percentage (%) of enterprises with innovation activity in total and by sector. E.U. member states. 1998-2004

E.U. member states	1998-2000	2002-2004
Country ***-15***	*44,0*	*45,1*
Belgium	50,0	51,3
Denmark	40,0	52,0
Germany	61,0	65,1
Greece	27,3	35,8
Spain	33,0	34,7
France	41,0	32,5
Ireland	65,0	52,5
Italy	36,0	36,3
The Netherlands	45,0	34,3
Austria	49,0	52,5
Portugal	46,0	40,9
Finland	45,0	43,3
Sweden	47,0	50,0
The United Kingdom	36,0	43,0
Luxembourg	48,0	52,2

Sources : EUROSTAT -CIS 3 & 4.

Government financial aid and assistance for the development of innovation seems to have bore fruits, since it has led to the increase of innovative activities in enterprises during the examined periods. The high percentage of the funded innovative enterprises (43,1% in 1994-96, 35,8% in 1996-98), in relation to the respective figures in the European Union that does not overcome the 21% (GSRT, 2007), indicates dependence of the innovativeness of Greek enterprises upon the government assistance. In the service sector, the percentage of the funded enterprises is much lower, around 20% (18,8% in 1994-96 and 20,0% in 1997-98).

IV- Strategic and organisational innovations

Strategic and organizational change is increasingly significant to the pace at which economic growth proceeds, especially in the services sector. Equally, it is increasingly difficult to separate these other strategic and organizational changes from innovation activity. Examples include marketing, strategic and management activities, organizational changes, and aesthetic changes in appearance and design. These new forms of 'innovation' have led to the introduction of terminology such as 'organizational innovation', which reflects new ways of organizing work, for example to take positive actions to involve all employees in decision-making, or restructuring an enterprise. 'Presentational innovation' has also been coined as a term to cover innovation in areas such as design and marketing.

Table 4 : Strategical and organisational changes in enterprise, 2000-2003. Greece

Activity	Economic sector		
	Manufacture (%)	Services (%)	Total (%)
Strategy	**50,5**	**53,6**	**52,5**
Management	**43,6**	**51,0**	**48,3**
Organization	**59,1**	**60,2**	**59,8**
Marketing	**50,0**	**54,4**	**52,8**
Aesthetic changes	**58,4**	**54,5**	**56,0**

Source : Kitsos, et. al. (2006).

Table 4 presents information for strategic and organizational changes that took place in enterprises between 2000 and 2003 for Greece and table 5 presents similar information between 1998 and 2000 for European Union. Changes in organization were the most frequently undertaken by the Greek enterprises (67%), and by the enterprises in European Union (53%) in total. Organizational changes concern the implementation of new or significantly changed organizational structures and the relations with other firms, such as alliances, partnerships, outsourcing and sub-contracting. Management changes were the less frequently undertaken by the Greek enterprises (48,3%), while marketing changes were the less frequently undertaken by the enterprises in European Union (38%). Management change concern the implementation of advanced management techniques within your enterprise. Marketing innovation concern changes in enterprise's marketing concepts/strategies and new or significantly changed sales methods or distribution channels, such as internet sales, franchising, direct sales, or distribution licenses. The market is constantly changing, it is becoming more global and new competitors are emerging. In addition technology complexity is increasing, product life-cycles are shortening, and knowledge is consolidating as a crucial input. All of these new characteristics of the market require the development of additional competitiveness from firms (Kitsos et. al. 2006).

Table 5 : Strategical and organisational changes in enterprise, 1998-2000. European Union

Activity	Economic sector		
	Manufacture (%)	Services (%)	Total (%)
Strategy	40	58	46
Management	34	47	39
Organization	49	62	53
Marketing	33	47	38
Aesthetic changes	41	44	42

Source : EUROSTAT –Community Innovation Survey.

Customers, owners and stock markets increasingly equate an organisation's worth with its ability to get winning products to market on time, every time. The rapid development of new technologies prompts firms to assess and implement the most appropriate technology according to their need to keep their competitiveness. Such a challenge can be too much even the most successful businesses.

Strategic and organizational changes are often associated with the rapid growth of the services sector and this is apparent when looking at the breakdown of the data presented in tables 4 and 5. The proportion of services enterprises introducing important strategic and organizational change was higher than the corresponding figure for manufacturing enterprises. More over, it's a rater a surprise to realize from our research that the Greek firms are informed from their suppliers, rather than the institutions, the research centers and universities.
Exceptions exist for aesthetic changes undertaken by the Greek enterprises (58,4% in the manufacturing sector against 54,5% in services). The undertaken by the Greek enterprises follow the changes in their organization at 56%, while the management changes undertaken by the enterprises in European Union follow changes in organization by 46%. Aesthetic changes concern significant changes in the aesthetic appearance or design or other subjective changes in products.

V- Challenges of the knowledge-driven economy in relation to changes

The knowledge-driven economy is a recent idea based on the long evolution of previous concepts such as knowledge, the knowledge economy, etc. A brief description of this evolution will help to understand the concept. The idea of the knowledge economy (1960s) originally appeared as a result of new trends and new types of data in the economy (Machlup, F., 1962). In the mid-1990s, the concept evolved to refer to least two supposed characteristics of the new

economy. Firstly, knowledge is more quantitatively and qualitatively important than ever before, and second, applications of information and communication technologies are the drivers of the new economy.

The knowledge economy can be said to be based on «an efficient system of distribution and access to knowledge as a sine qua non condition for increasing the amount of innovative opportunities. The OECD defines knowledge-based economies as “economies which are directly based on the production, distribution and use of knowledge and information” (OECD, 1996). It is not simply about pushing back the frontiers of knowledge; it is also about the more effective use and exploitation of all types of knowledge within all manners of economic activity.

Economies have been becoming increasingly knowledge-based for a long time. Currently however, four influences can be identified as increasing the speed of change: a) extraordinary progress of Information and Communication Technologies (ICT), b) increased speed of scientific and technological advance, c) increased global competition, facilitated in part by reduced communication costs and d) changing demand associated with rising incomes, and the changes in tastes and attitudes to leisure that come with greater prosperity. It is a reality that for countries in the vanguard of the world economy, the balance between knowledge and resources has shifted so far towards the former that knowledge has become perhaps the most important factor determining the standard of living (World Bank, 1998).

Today's most technologically advanced economies are truly knowledge-based. The development of a knowledge-driven economy involves a period of adjustment and structural change. This development changes the way firms compete; better access to global markets is part of the equation, but so are alternative management methods and organisational structures. Such technological developments and changing approaches are creating whole new kinds of products. The evolution from a technological network perspective of innovation management to a social network perspective has been led by the challenge to transform information into knowledge (e.g. information contextually connected to the development or improvement of products or processes).

Knowledge-based innovation requires not one but many kinds of knowledge. Furthermore, it requires the convergence of many different kinds of knowledge retained by a variety of actors. The systemic approach to innovation (Nelson, R.R., 1993) recognises that innovation and knowledge generation take place as a result of a variety of activities, many of them outside the formal research process. Knowledge is thus generated not just in universities and research centres, but also in a very wide variety of locations within the economy, and notably as a product (learning-by-doing) or of consumption (learning-by-using). In comparison to traditional mechanistic command and control management, these characteristics entail a fundamental change in the strategic perception of the organisation.

Modern management has to face the perpetual challenge to place the human being at the fore front of operations, and understand that an organisation is a collection of different human beings. People have different attitudes, different customs, different professional backgrounds - management should focus on integrating the web of formal and informal relationships inside and outside the company. If the organisation is to stay responsive to external change, a flexible and adaptable organisational structure is a necessity. The challenges of the new knowledge-driven economy concern new characteristics of the market, new types of innovation, new needs of stakeholders, new approach to innovation management, new technology innovation assessment skills, and need for new innovation management tools.

The market is constantly changing, it is becoming more global and new competitors are emerging. In addition technology complexity is increasing, product life-cycles are shortening, and knowledge is consolidating as a crucial input. All of these new characteristics of the market require the development of additional competitiveness from firms. Customers, owners and stock markets increasingly equate an organisation's worth with its ability to get winning products to market on time, every time. The rapid development of new technologies prompts firms to assess and implement the most appropriate technology according to their need to keep their competitiveness. Such a challenge can be too much even the most successful businesses (Christensen, C., 1997).

The development of knowledge-based innovation management requires the capacity to implement technical and relational tools. Technical tools refer to the acquisition and utilisation of new information and communication technologies - they do not create competitive advantage because they are readily available to others. The creation of competitive advantage rests in

relational tools -the way of doing business, both in the internal and external environments of firms (Myers, P., 1996).
The implications for the new agents of innovation in the context of the knowledge-driven economy are being felt right across the economy and involve new ways of working. For firms, competitiveness increasingly requires them to build distinctive capabilities. Managers, need to maintain, develop and utilise these knowledge assets due to the quest for competitive advantage increasingly.
As to employees, new types of incentive structures are required to ensure they are motivated and retained. Investors consider that more of a firm's wealth-creating potential is tied up in intangible assets, including the knowledge of the workforce. For the policy maker, the challenge is to create a framework which supports continued development of scientific and technological excellence, greater competition and a culture of innovation.

VI- Conclusion

The results presented in this paper, part of the research we carried out as it has been mentioned, show clearly that enterprises in the services sector appeared more inclined than manufacturing enterprises to introduce strategic and organizational changes. This result is in contrary to the general belief that there is a higher propensity to innovate within the industrial sector. Both European Union and Greek enterprises were more likely to engage in organizational changes, while management changes were more frequently undertaken by the enterprises in E.U. against the Greek enterprises. This was not expected as the Greek firms have to reach the E.U. level and more likely to engage in aesthetic changes. In the knowledge-driven economy, establishing bridges between knowledge and the marketplace the right environment for innovation is the key to building competitiveness. The knowledge economy also represents new opportunities and requires some design actions to support and take advantage of this economy (Kitsos et. al. 2006) and the Greek firms have to realize this. It is the firm that organizes the creation of value. In principle, the shortening of product cycles, firms face the need for more capital-intensive investment and must put more emphasis on the ability to react quickly. For the Greek firms, innovation is a crucial means to create competitive advantage and superior customer value. Except for certain types of technology-based firms, the focus is not on the technological aspects of new product development, but on innovative ways to improve their position in the market. Innovation takes many forms (Hatzikian 2007). There is technological innovation, but also innovation through new business models and new ways of organizing work, innovation in design and in marketing. Innovation can also consist of finding new uses and new markets for existing products and services (Kitsos, Korres, Hatzikian 2006).
We emphasized the importance of pursuing efforts to develop knowledge and developing information and communication technologies. The new management techniques and manpower training to improve productivity is also crucial. In innovation management, there is a wide range of techniques which should be adopted and implemented by the interesting business and academic partners.
In order to reach this aim, we propose the following typologies of innovation management techniques to be considered:

- Knowledge management techniques.
- Market intelligence techniques.
- Cooperative and networking techniques.
- Human resources management techniques.
- Creativity development techniques.
- Innovation project management techniques.
- Design management techniques.
- Business creation techniques.

In the knowledge economy of E.U., products and companies live or die by information. It seems the most successful companies are those that use their intangible assets better and faster. Knowledge and information are today the drivers of thriving companies, much more so than land, capital or labor. Corporate reporting is still founded on a financial and management accounting model. This model was developed for the industrial economy and is not able to deal with today's knowledge

economy, where most corporate value creation is based on knowledge assets rather than on physical resources and financial capital.

Acknowledgement

We would like to thank the Greek Ministry of National Education & Religious Affairs and the European Union for the financial support they provided to this research, correspondingly 25% and 75%, under the framework of the "Archimedes - Education and Initial Vocational Training Program".

References

Christensen, C. (1997). *The Innovator's Dilemma*, Harper Collins.

European Commission (2004) Innovation Results for the EU, Iceland and Norway, Data 1998-2001 (CIS III), Luxembourg: Office for Official Publications of the European Communities.

Hatzikian, J. (2007) Research and technological development policy and innovative performance : The Greek case within the EU, p.p. 229-250. In George M. Korres (Editor), Economic Integration and Regional Growth. Germany : Springer Editions.

GSRT (2007). *National Innovation Survey (CIS 4) in Greek Enterprises 2002-2004, Summary,* GSRT - General Secretariat for Research and Technology - Ministry of Development, Athens.

Kitsos C.P., Korres G., Halkos G., Hadjidima S., Hatzikian Y. (2006) Women and Innovation: Determinant factors and obstacles of innovative activity of Greek firms: 2000-2003: ARCHIMEDES research project, Athens : TEI of Athens (In Greek).

Kitsos, C. P, Hatzikian, Y. (2006) Innovation Management and Greek Entrepreneurship, 17th ISPIM Annual Conference, Athens, Greece, 11-14 June 2006. In Proceedings e-volume.

Kitsos C. P., Korres G. M. , Hatzikian Y. (2006) Statistical Analysis on Entrepreneurship and Innovation Activities for Greek Enterprises. In Hellenic Statistical Institute Conference, 26-29 April, Kastoria, Greece, 2006, p.p. 603-612.

Machlup, F. (1962). *The Production and Distribution of Knowledge in the United States.* Princeton University Press.

Myers, S. and Marquis, D.G. (1969), *Successful Industrial Innovation,* National Science Foundation, Washington D.C.

Nelson, R.R. (1993) National Innovation Systems: a Comparative Analysis, Oxford: Oxford Univ Press.

OECD (1993), Frascati Manual. OECD : Paris.

OECD (1996). *The Knowledge-Based Economy,* OECD : Paris.

OECD (2001), Science, Technology and Industry Scoreboard : Towards a Knowledge-Based Economy,

OECD (2005), Oslo Manual. OECD : Paris.

World Bank (1998). Knowledge for Development, World Development Report, New York, Oxford: Oxford Univ Press.

Getting a Grip of Customer Value Creation in Developing Industrial Services

Iiro Salkari[1*], Tapani Ryynänen[1]

VTT – Technical Research Centre of Finland, Espoo, Finland

* Corresponding author: Iiro Salkari, VTT, P.O. BOX 1000, 02044 VTT, Finland;
Phone +358 40 525 4771

Abstract: This paper discusses how to make business out of services by better understanding their effects on customer value creation. The focus of the paper is on industrial services offered by machine manufacturing companies. In this paper, we firstly identify the potential value creation logics beyond Porterian value chain and related justification. Secondly, we present an approach and a tool for formalising how a service supports customer value creation. Thirdly, we illustrate through a tool, how a service can be specified based on how it supports customer value creation. The approach adopts the different views concerning value creation that the customer stakeholders may have to the very same service. The outcomes of the formalisation are basis for sales argumentation and pricing, and a starting point for specifying service processes. The paper is based on a research project supported by three industry cases and on industry-lead roundtable work. The cases and round table participants represent medium and large companies in machine manufacturing industry.

Keywords: service business; industry; value creation; service specification; service development

I- Introduction and Motivation

The industrial companies expect increasing significance of services as a part of their business and a source of growth. In a Finnish survey (Accenture, 2005) two thirds of the companies reported that the after sales market growth was 10% per year during the period of last three years. One third of companies reported annual growth rates of over 20%. At the same time, over half of the companies (60%) that answered the inquiry estimated that the value of the after sales services is less than 10% of their turnover. Furthermore, service business is often considered as less sensitive to economic fluctuations than capital business. These figures and findings imply that service business is an opportunity for steady, long-term growth for industrial companies.

Realising this potential profitably calls for moving from favours to industrial service business. Companies in machine manufacturing industry have a long tradition of providing favours, but they are less experienced in formalising these favours into conceptualised services, not to mention making money out of them. Based on our research, a central challenge in turning services into business seems to be that services change the way in which customers' value creation is supported (Salkari et al., 2007). In product based innovations, this value innovation seldom takes place, and probably therefore is seldom considered by companies nor in the more traditional views on innovation. However, this kind of value capture innovation and solution innovation are recognised as innovation types in the Innovation Radar (Sawhney et al., 2006).

In the following chapters we identify the potential value creation logics beyond Porterian value chain and related justification, we present an approach and a tool for formalising how a service supports customer value creation, and we illustrate through a tool, how a service can be specified based on how it supports customer value creation.

The paper is based on previous research and three industry cases that support a Tekes-funded research project, and on industry-lead roundtable-work of RoundTable 4/2008 in BestServ Industrial Service Business Forum. BestServ Forum has altogether over 30 industry members and 6 of these participated the RoundTable 4/2008. The three case companies and six roundtable participants represent medium and large companies in machine manufacturing industry.

II- Logic of value creation is in change

The prevailing modus operandi in many machine manufacturing companies is in the product or goods based world where the very much dominant value creation logic is the Porterian value chain. In the value chain logic the value arises from cost-efficient delivery of specified components.

Other more recent value creation logics are value shop and value network (Stabell and Fjeldstadt, 1998) or value web (Riis et al., 2007). In the value shop, the key competitive factor is not solely cost efficiency, but rather the value of the solution to the customer. In the value network – or value web – the value is derived from the number or quality of direct or indirect connections provided or mastered by a node. Table 1 summarises some characteristics of the value logics studied by Stabell and Fjeldstadt.

Table 1. Some characteristics of chain, shop and network value creation logics

	Chain	**Shop**	**Network**
Value elements	Components (often physical)	Competencies	Connections
Deliverable	Transaction	Solution that supports customer business.	Connectivity
Value creation logic	Efficiency (low costs)	Solution with a high value	Quality or number of connections

Based on the interviews of 14 key persons in the 3 case companies it seems that in service business other than value chain logic emphasise more compared to product based business and companies should manage business models that are based on a mixture of different value creation logics. Chain is still important for profitable business, but understanding shop and network logics and turning them into customer values seems to become critical when developing service business beyond spare part sales. Service business beyond spare part sales includes e.g. lifecycle services for installed base, performance services for installed base, operation of installed base or even providing the final outcome instead of production machinery. In the interviews and roundtables, many interviewees and roundtable members expressed that profitable delivery of some of these services require ICT, and thus service development should be integrated with product development. When we speak about services in this paper, we consider that they include the necessary ICT also.

Value shop logic

Think of e.g. maintenance or performance agreements, where we already move from transactions towards joint processes that aim to ensure an agreed performance level. This already affects on value creation logic: efficient delivery of a transaction is not enough but the performance based service contains also a solution aspect. The service provider can not only focus on delivering a service efficiently but he has to analyse also the processes more large: how to improve the operative and even business processes of the customer so that the performance level is achieved. In earning logic this means that a solid service business can not only be build on low costs, but on high value outcome (which is the agreed performance level) of the service.

Systemic nature of service business and network logic

Service is not developed nor delivered solely by the service provider, but also service provider's contractors' and customer's involvement in the service development and delivery is required. Services can be considered as joint process-like endeavours of service providers and the customer (e.g. Grönroos, 2000). As a consequence, services are conducted in collaboration between the parties beyond collaboration of only sales and purchases processes. In practice this means that several levels and functions of the parties need to collaborate. Further, service provider needs to integrate with partners, who bring in different competencies that are needed

in order to deliver the desired value. When doing so, the service provider acts in a network mode by building up and managing a value web (see e.g. Riis, 2007).

III- An approach for analysing customer value creation

Roundtable (BestServ RT 4/2008) members (6 members from 6 companies) identified altogether 14 main factors through which it is possible to evaluate in their businesses, how a service supports customer value creation. These factors are: safety; easiness; fluency, flexibility, brand and image, environmental factors; applicability to rules and regulations; status follow up and documentation; economics; performance; productivity; reliability; serviceability; comfortability. Further, the roundtable members identified over 70 sub-factors that can be placed under the 14 main factors.

Another main finding of the roundtable was the different customer's internal interest groups that need to be taken into account when analysing how customer value creation is supported. Customer's internal interest groups cover strategic, business process and operational levels. In concrete terms, the identified interest groups include e.g. operations and production; purchasing; logistics; maintenance; safety management; project or application management; middle organs; sales; top management. The way in which a service supports value creation of these stakeholders varies. For instance, top management may consider effects on financial performance, middle management on process performance, and operational level on the work flows. All are of course thinking how the service will change their own work.

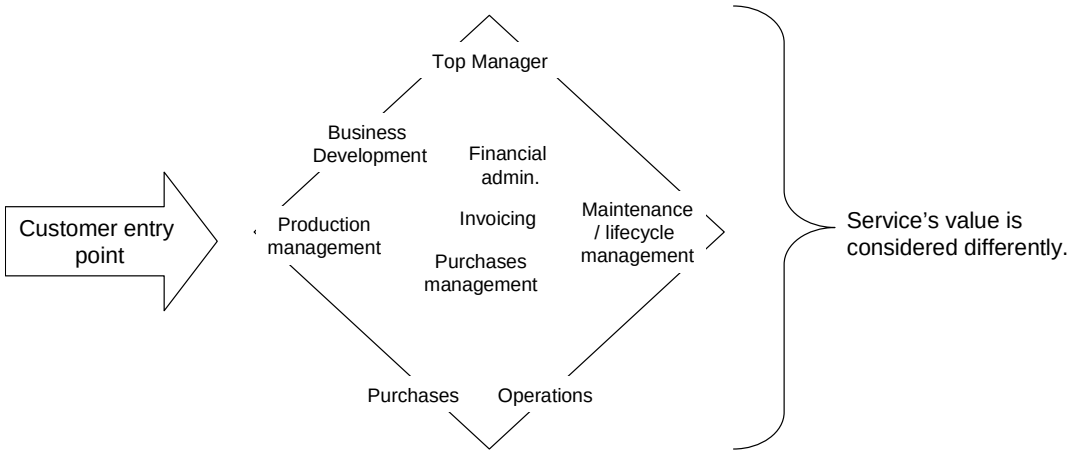


Figure 1. How customer perceives service value creation depends on which stakeholders are we talking with.

Considering these findings and the three types of value creation logic (chain, shop, network), we notice that the factors can not be unambiguously linked with a single value creation logic. Instead, when we analyse customer value creation we need to take customer's internal interest group into account and analyse what aspects of the three value creation logics each of the factors bear for the interest groups in question. Further, the list of factors does not appear unambiguous, but rather it is a list that includes important factors, but is not complete considering all businesses. Hence, the list of factors should be carefully identified taken into account the customer and those customer's interest groups that are relevant, i.e. to whom we are clarifying the benefits of the service. After that, a description how the service supports each of the factors can be made.

In order to crystallise this approach for analysing customer value creation, we built up a matrix tool. The columns of the tool represent the selected factors through which we think that the service might support customer value creation. The factors need to be carefully analysed and selected. The lines of the tool represent services in question. The shells in the intersections contain description, how the service supports the selected factors of customer value creation.

The descriptions are made from customer's viewpoint. The applier of the tool needs to be aware of the different value creation logics when making the descriptions for different factors and customer interest groups. The descriptions can be iterative from quite loose verbal ones to more formal mathematical ones.

Table 2 gives an example how to apply the matrix tool. The example is a generalised extract of an exercise that was conducted by one of the case companies. The example includes an easy-to-understand spare part management outsourcing service, and factors that are listed in the first row were selected by the case company to fit those services which they analysed. The example emphasises, how the service supports value creation from top management's viewpoint. Besides this example, the matrix was applied to a greater number of services within the case company in question. Further, the tool is also applied in the other three case companies.

In the example, the value chain logic is included in the cost cutting argumentation while shop logic is included in other benefits like enabling concentration to core competencies and enabling increased uptime to customer's production machinery, because the right spare parts are available. The network logic is also included in the descriptions: the service provider manages the right connections and the practices to collaborate with these connections. These connections may include spare part deliverers (other than the company that provides the service) and an insurance company.

Table 2. Example of analysing the customer values of a service.

	Lower costs	**Less tied capital**	**Minimizing risks**	**Easiness of life**	**Spare part supply chain**
Top mngmnt	Invoicing based on agreement (reduce number of invoice). Less downtime. Less or no investments on spares.	Less inventory. Ownership of inventory: service provider owns inventory. Reduce waste due to aging inventory.	Selected / most critical components are available.	Requests for quotation (RFQ) is not needed. Purchasing orders not needed (because longer term agreements exist) Spare part/ warehouse management outsourced	Service provider manages the right contacts, contracts and processes to different spare part suppliers.
Middle mngmnt					
Ope-rations		*…descriptions here…*			
Support functions					
…					

This approach and the example analysis that we made clarifies the potential values of a service to a customer. Finally, the customer needs to consider, how the service fits to their strategic choices, business processes and operative possibilities, and only if this analysis shows green, the potential may be realised (Salkari et al., 2007).

IV- Customer value based specification of service business

Equally, when developing services also the service provider needs to reflect how the service that would deliver the desired customer values fits to his own strategic, business process and operative choices and possibilities (Salkari et. al, 2007). In practice, this means that sustainable service business rests on the customer values to the extend that is sustainable from service

provider's viewpoint. This may compromise the value to the customer, but other way around the service might compromise the supplier's own business, which actually is equally harmful for the customer too. If customer value is compromised too much, then there is no place for this service – at least with the service provider in question.

Again, we illustrate this in the form of a matrix tool. The matrix is shown in table 3. In this matrix we consider the influence of delivering the identified values against service supplier's strategy, business processes and operational level choices and competencies. For instance, on strategic level we would consider service suppliers strategic positioning in the market, necessary networking and related competencies. On business process level, we would consider what kind of business processes there should be in order to deliver the intended values to the customer key and support processes. On operational level we would again think of our operational competencies and the actual workflows needed to deliver the service. In developing services, it seems that considering the service specification against own business choices is crucial because the value creation logic, earning logic and the whole business model on most strategic level face pressure for change, and these changes need to be conscious and controlled in order to avoid drifting into unprofitable or unsustainable business. The tool can be applied iteratively so that finally it produces a service specification that is acceptable from strategic, business process and operative viewpoints.

The core idea of this matrix tool is based on Quality Function Deployment (QFD) methodology (see e.g. Akao Y., 1990) and it is also influenced by know QFD application, House of Quality (e.g. Madu C., 2006). The QFD methodology is mostly applied in customer need driven new product development. It can also be used for services and processes, but there are fewer applications in that side. This may be because customer driven service development challenges the prevailing earning logic and business model, and is therefore risky if conducted without proper criticality.

Table 3. Customer value based specification of service business

How factors support customer value creation / **Choices and compe-tencies**	**Lower costs**	**Less tied capital**	**Minimizi ng risks**	**Easiness of life**	**Spare part supply chain**
	Invoicing based on agreement (reduce number of invoice). Less downtime. Less or no investments on spares.	Less inventory. Ownership of inventory: service provider owns inventory. Reduce waste due to aging inventory.	Selected / most critical compone nts are available.	Requests for quotation (RFQ) is not needed. Purchasing orders not needed (because longer term agreements exist) Spare part/ warehouse management outsourced	Service provider manages the right contacts, contracts and processes to different spare part suppliers.
Str. choices and compe-tencies					
Business level choices and compe-tencies		*Descriptions here.*			
Operational level choices and compe-tencies					

Outcome of this tool is a very rough three-level (strategic, business process, operative) requirement specification of the service that would deliver the desired customer values. If the specification is reasonable compared to supplier's business choices and competences, the actual service process development can begin, and the business model can be built on the top of the understanding gained through this approach. By reasonable we mean: fits with existing or with intended development directions.

The matrix tool presented in table 2 is only piloted once in one of the cases and currently we working in order to understand better the useful level of details for making the descriptions and specifications. It seems probable that some generic things can be defined, but again the case in question may affect a lot. It also seems, that the matrix is suitable for clarifying the approach, but not for documenting all the information. Instead, the information may be documented in some other format, or by utilising some application other than just simple Excel-matrix. The pilot of the other matrix tool in table 3 is only done superficially, however the aim is to make a more thorough service definition, based on the tool, in this pilot.

V- Conclusions

In this paper we identified potential value creation logics beyond value chain and discussed the service business value creation in the context of machine manufacturing companies. We also presented an approach for analysing how a service supports customer value creation. This is the main contribution of this paper. We also presented an approach how to make a rough specification of a service that delivers the identified values. The approach produces the rough specification in such a format that the fit on service supplier's business can analysed. The rough service specification (matrix in table 3) is a starting point for service process development, and the value matrix (table 2) can be used as a starting point for formulating the earning model, and also sales argumentation. Based on the experiences we have had in the three case companies, this approach seems appropriate for defining industrial services.

During our research it has become evident that this kind of systematic approach is heavy to carry out, which is also the common challenge of different applications of QFD techniques. It seems that, the best payback for using the systematic approach that we presented is gained with services that build on a mix of different value creation logics. Often these services are actually some sort of service bundles involving service provider, customer, service provider's network and also enabling ICT. In case of simple services, the level of details needs to be thought of carefully in order to avoid heavy work that yields only banal information. Although the approach is created for machine manufacturing companies that develop service business, the approach seems appropriate for other business contexts as well. However, the approach emphasises understanding how a service supports customer value creation, because this is in change in the context of machine manufacturing industry. Therefore, mechanical copying to other business contexts may not be beneficial.

The aim is to continue studies concerning customer value based specification of services. In practice this means more pilots that apply the approach illustrated in the table 3. The approach will be developed further based on the experiences of these pilots.

References

Accenture, 2005. Suomalaiset teollisuusyritykset hakevat kasvua jälkimarkkinoilta. Press release 19.9.2005.

Akao Yoji, 1990. Quality Function Deployment – Integrating Customer Requirements into Product Design. Productivity Press, Portland, Oregon. 387 p.

BestServ Forum, see: www.bestserv.fi

Grönroos, C., 2000. Service Management and Marketing: A Customer Relationship Approach. John Wiley and Sons Ltd (2nd ed.). West Sussex. 404 p.

Madu, C., 2006. House of Quality (QFD) in a Minute. Chi Publishers (2nd ed.). Fairfield. 116 p.

Riis J., Johansen J., Waehrens B., and Englyst L., 2007. Strategic roles of manufacturing. Journal of Manufacturing Technology Management. Vol.18, No.8. Pp.933-948.

Salkari, I., Hyötyläinen, R.,; Apilo, T.; Ryynänen, T.; Korhonen, H., 2007. Uutta asennetta palveluinnovaatioihin. In: Grönroos, C. et al., Teollisuuden palveluksista palveluliiketoimintaan - Haasteena kannattava kasvu. Teknologiainfo Teknova Oy. Helsinki. 172 p.

Sawhney, M., Wolcott, R. C., Arroniz, I., 2006. The 12 different ways for companies to innovate. MIT Sloan Management Review, Vol 47, 3. MIT-Massachusetts Institute of Technology. Pp. 75-81.

Stabell C.B., and Fjeldstadt Ø.D., 1998. Configuring Value for Competitive Advantage: On Chains, Shops, and Networks. Strategic Management Journal, Vol.19. Pp.413-437.

Innovation Benchmarking for Manufacturing SMEs

O. Som[1,*], E. Kirner[1]

[1] Fraunhofer Institute for Systems and Innovation Research, Karlsruhe, Germany

* Corresponding author: oliver.som@isi.fraunhofer.de, +49(0)721-6809-337

Abstract: In the manufacturing as well as in the service sector, SMEs are often characterised by a lower ability to innovate compared to large companies. Thus, it is necessary to encourage SMEs to think more about their innovativeness and make them aware of potential improvements of their innovation behaviour. The provision of an online self-assessment tool is one way to realise a fast, simple and cost-effective possibility of self-evaluation for SMEs. The paper discusses the theoretical and methodological aspects of innovation measurement at the firm level as well as the specific requirements of such a self-assessment tool to meet the needs of SMEs. Furthermore a first implementation of an online self-assessment tool is described including a set of detailed indicators for measuring the innovativeness of SMEs in its various dimensions. Finally, the constraints and limits of the self-assessment method are discussed.

Keywords: innovation benchmarking, self-assessment tool, innovation measurement, SME

I- Why innovation benchmarking for SMEs?

Small and medium sized enterprises (SMEs), which represent the majority of companies and also employ the majority of the workforce in the European economy, are especially challenged by the increased innovation pressure of global markets. They are forced to increase the effective and efficient use of their resources for innovation and thus to increase their innovation ability to survive in competition. But, as several studies argue, SMEs are often characterised by a lower ability to innovate compared to large companies due to their lower innovation expenditures and missing effects of scale and scope (Acs/Audretsch 1988; Vossen 1998). This applies for the manufacturing sector as well as for the service sector. Thus, it is necessary to encourage SMEs to think more about their innovativeness and make them aware of potential improvements of their innovation behaviour. Therefore it is necessary to provide them with valid and reliable information about their current innovation ability by measuring it in it various dimensions. The old management adage "you can't manage what you can't measure" is still valid today. Unless something is measured potential progress cannot be evaluated. It's impossible to manage for improvement if it is not possible to determine whether the efforts have been fruitful or not. SMEs are often characterised by a lack of such a systematic measurement system of their innovation performance. To identify their particular strengths and weaknesses regarding innovation, SMEs furthermore need information on their position relative to their competitors. Thus, the provision of a benchmarking tool to access the innovation ability is one way to offer a fast, simple and cost-effective possibility of self-evaluation for SMEs. Besides such practical aspects, the paper discusses the major challenges developing a benchmarking tool to measure the innovativeness of SMEs regarding the type of benchmarking to be deployed as well as the measurement indicators which should be included.

II- Measuring Innovation in the frame of a benchmarking tool

Benchmarking represents one type of the wide range of controlling instruments for measuring and increasing the competitiveness of enterprises by asking about the reasons for superior performance of competitors (Straub 1997). For this purpose, the characteristics of the own firm are being compared for example to other firms, other structures, particular competitive situations or external customer requirements (Zdrowomyslaw/Kasch 2002). Benchmarking thus describes a systematic procedure for the comparison of an enterprise with other companies by which can not only be identified if differences are occurring at all, but also which room for improvement exists (Stocker 2007). Benchmarking as a management tool plays an important role since the 1980s and has developed into an effective tool of firms' performance measurement and improvement of competitiveness (Legner/Österle 1999).

Especially for SMEs, it is important that the benchmarking can be carried out in a resource-friendly and feasible way. Often, capacity bottlenecks and time pressure hinder SMEs to undertake a benchmarking process. Thus, a benchmarking tool for SMEs has to be practical and easily comprehensible as they frequently lack controlling or management experts (Mertens 2006). For that reason, it is also recommendable to provide support for the interpretation of the benchmarking results and to highlight potentials for improvement and corresponding options for action (Ziegele/Hener 2004).

III- Types of benchmarking

Basically, two types of benchmarking can be distinguished: general benchmarking and best-practice benchmarking (Bandow 1998). While the first one stands for the mere comparison of firms' key data or management ratios to identify rooms for improvement, the second one represents the comparison with the respective best performers in order to learn and adopt their best practices. Furthermore, the purpose of benchmarking can be differentiated into strategic and tactical goals. Strategic benchmarking aims at the long-term assurance of the competitiveness of the enterprise by inducing processes of learning, reorganising and change within the firm (Watson 1993). Instead, the tactical benchmarking focuses on general, elaborate success factors or on deficient fields of business (Bretschneider/Stang 2004). Within the operative level, product-related as well as process-related forms of benchmarking are distinguished, which target either on product or process optimisation (Watson 1993). Benchmarking procedures within the enterprise, for example between different subsidiary companies, different departments or different working groups are considered as internal forms of benchmarking (Grieble et al. 2002). They are especially deployed in large firms with a high degree of decentralisation and allow for the evaluation and harmonization of the performance of the separated functional units (Hunziker 2008). In contrast, external benchmarking aims at the comparison with third-party enterprises (Stocker 2007), either within or between sectors (Puschmann/Alt 2002).

IV- Indicators for measuring the firms' innovativeness

Most existing studies on the innovation ability of firms only focus on R&D-based dimensions of innovation such as product innovativeness and – to a lesser degree – on technological process innovation by using indicators like patent assignees, firms' R&D-expenditures or the development of new products. This circumstance is also due to the fact, that these indicators are relatively easy to measure and that they have a close relation to a corresponding outcome. However, R&D-related indicators as overall indicators for innovation as a whole have shortcomings with regard to the one-sided emphasis they put on formalised R&D-activity within the enterprise. Since technological innovations in SMEs tend to take place within lesser formalised structures, their measurement through these indicators might provide inaccurate results (Becheikh et al. 2006; Smith 2005). An even further reaching shortcoming of such R&D-related indicators lies in the circumstance that they neglect the non-R&D dimensions of innovation and performance which might be equally important for firms' competitiveness and competitive success, especially in the case of SMEs.

To address the innovativeness and performance of SMEs, it therefore seems reasonable to measure their innovation ability not only by classical R&D indicators, but also by indicators related to quality, process speed, efficiency and product related services. Assuming that firms are subject to different external frame conditions, it is necessary to acknowledge that different groups of firms might achieve competitiveness through different innovation paths which might not always be related explicitly to a product innovation strategy. An empirical survey of British firms revealed that product quality and short delivery and lead times are as important for the competitive advantage of SMEs as the products themselves (Cosh/Hughes, 2003). The proposed measurement system for a self-assessment tool for the innovativeness of SMEs therefore adopts a holistic and encompassing definition of innovation as already proposed by Schumpeter (Schumpeter 1934, Dreher et al. 2005). Schumpeter has originally distinguished five different types of innovation: new products, new methods of production, opening new markets, new sources of supply for raw materials and new forms of organisation. Many scientific contributions have underlined the need for a broadened understanding of innovation which also

includes non-technological innovations such as service and organisational innovations (i.e. Totterdell et al. 2002, Damanpour 1987, Lam 2005, Damanpour et al. 1989, Greenan 2003, Drejer 2004, Hipp/Grupp 2005). The latest edition of the OSLO Manual which represents the methodological basis for major innovation studies has also taken up this wide understanding of innovation and proposes a holistic understanding of innovation (OECD 2005) by explicitly considering different types of innovation such as product, process, organisational and marketing innovations. According to the Oslo Manual, innovation in this broader understanding can have effects on various performance aspects at firm level and can be measured along different dimensions such as for instance reaction time, market share, flexibility, input cost reduction, customer orientation, reduction of lead times, quality improvement or better knowledge management (OECD 2005).

As these remarks also point out, the innovativeness of firms consists of the interaction between input and output dimensions. Innovation inputs (like R&D-expenditures, share high-qualified personnel etc.) stand for the starting conditions the firm brings into its innovation process. As innovation is not an end in itself, but a means to reach, maintain and increase competitiveness and economic success (Schumpeter 1934; Tidd et al. 2005; Vahs and Burmester 2002) it is also important to asses the output dimensions of the firms' innovation activities. Output measures (i.e. share of sales with product innovations, productivity, manufacturing lead time etc.) represent the performance dimension of the undertaken innovation efforts. Focusing only on one dimension would not provide sufficient information for the benchmarking firm as a similar innovation performance can be achieved by totally different ways of innovation strategy and vice versa (Kirner et al. 2006). Thus, for really being able to compare firms' innovativeness, it is necessary to know which performance is achieved by which input. In consequence, the considered fields of innovation should be measured by both, input and output indicators.

As a third point, the development of a benchmarking tool to assess the innovativeness of SMEs imposes the necessity to select some key indicators according to this broad understanding of innovation. On the one hand, SMEs often do not systematically investigate all theoretically relevant indicators or – in worst case - even do not measure them at all. So there is a trade-off between theoretical need and the feasibility. On the other hand, like in every empirical questionnaire the answering of all of the questions should not exceed a reasonable amount of time. Thus, one of the major challenges of the design of such a benchmarking instrument lies in the thorough selection of a set of indicators.

V- Conceptualisation of an innovation benchmarking tool for SMEs

In this chapter, some conceptual thoughts concerning the design of such a benchmarking tool are suggested. A first implementation of such a tool for the German manufacturing industry has been developed in the project "innokmu"[1] and can be tested at www.innoscore.de. The tool combines quantitative measures as well as qualitative success factors in two different modules. This paper focuses only on the quantitative modul.

Type of benchmarking

Following the practical needs of SMEs, an innovation benchmarking tool could be reasonably conceptualised as an online self-assessment tool. Thereby, SMEs are able to carry out the benchmarking whenever they want on their own without being bounded to fixed deadlines or cost-intensive external consultants. Thus, the inhibition threshold for SMEs to deal with innovation management issues might also be lowered by such a self-assessment. If any required data is missing or not at hand, there is enough time to investigate and resume a saved intermediate result at a subsequent point of time.
To provide a first objective positioning of the benchmarking SME relative to its comparable competitors and to become aware of the own strength and weaknesses especially as regarding quantitative measures, we argue for the method of a general, strategic benchmarking instead of a best-practice benchmarking. Best-practice solutions often assume that there is only one way

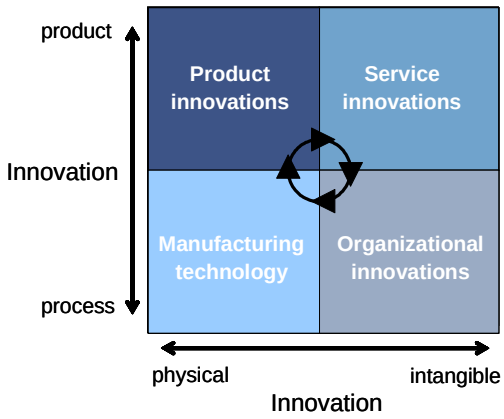
[1] more information available at: www.innokmu.de

to optimize internal procedures and strategical orientation that fits for all enterprises (Bea/Haas 2005). Best-practices have often evolved through a long-term mutual adjustment of strategic goals and internal routines to the specific frame conditions in which the top-performer is embedded (Porter 1996).

Innovation indicators

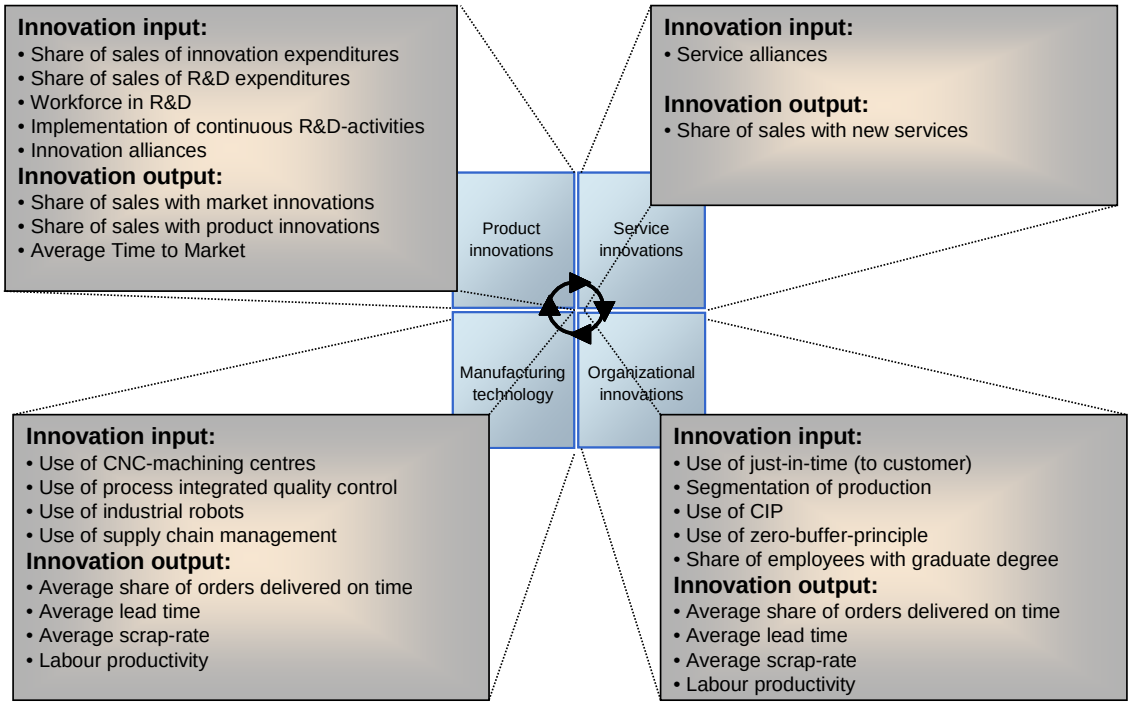
To provide a systematic, theory-driven selection of the included innovation indicators we followed a typology of firm-related fields of innovation developed by Kinkel et al. (2004) and Dreher et al. (2005). They distinguish between a physical versus an intangible dimension and a product-related versus a process-related dimension of firm's innovation activity. The circled arrows stand for the various interdependencies between the different fields (Figure 1).

Figure 1: Holistic Model of firm's innovation activities



According to the requirement of this holistic and broad understanding of innovation, it is necessary to provide indicators not only for product or technology-based dimensions of innovation. Thus, we argue for input and output indicators for each different field of innovation (Figure 2). For the field of product innovations it is recommendable to follow the OSLO-Manual by using indicators like "share of sales with new products", "R&D-expenditures", "R&D-cooperation" or "Time to Market" (OECD 2005). Regarding the subject of service innovations which are likely not based upon R&D-activities, some of the "product-indicators" can easily be transformed as the offering of service can be interpreted as being a kind of immaterial product. Thus it's possible to ask for share of sales of services or whether the enterprise takes part in service cooperations with other firms. With regard to possible performance measures that could be affected by process innovations (both, process and organisational), it is possible to distinguish between three major dimensions of impact (Wheelwright/Clark 1992; Armbruster et al. 2007; Kirner et al. 2006; Westkämper et al. 1998): time (acceleration of processes), flexibility (more variability in the processes of adaption to internal or external challenges) and quality (reduction of errors occurring within or between single production and operative processes). But it should be kept in mind that the differentiation between the three performance dimensions time, flexibility and quality is very idealized, because one innovative procedural concept may trigger all of these dimensions simultaneously. As regards an empirical impact analysis this means that all of these three impact dimensions should be taken into account. On the input side of process innovation it is possible to ask for the use and the intensity of use of different manufacturing technologies or organisational concepts. To provide the validity of the data input in the context of the self assessment it is furthermore desirable to simultaneously check for intra- (i.e. definition of a certain range of values) and inter-plausibility (i.e. inconsistencies between inputs).

Figure 2: Quantitative innovation input and output indicators for benchmarking manufacturing SMEs



Type of Database

Another aspect which has been already mentioned is the need for comparison with other either similar or different manufacturing SMEs in order to be able to identify the own competitive advantages or shortcomings regarding innovation performance. One possibility could be to deposit a dynamic database which is generated and evolved by recording the users of the self-assessment tool. But this method houses some difficulties which reduces the validity of the results. Each user gets a different result, as the underlying database would be changing and modifying continuously. Besides, it'll take a critical amount of users to be able to build adequate reference groups of size, sector and other structural variables for meaningful comparisons with other firms. Thus, the proposed way is to provide a representative and static database which allows for stable, comparable results and for the selection of meaningful reference groups for each user.

Therefore we have chosen the German sample of the "European Manufacturing Survey 2003" conducted by the Fraunhofer ISI[12]. The objective of this regular, questionnaire-based, mailed survey is the systematic monitoring of manufacturing industries. The survey addresses firms with 20 or more employees from all manufacturing sectors (NACE 15-37). The 6-page questionnaire includes questions on the implementation of innovative manufacturing technologies, on organisational innovations, on cooperation, on relocation, on performance indicators, on products and services, as well as on general company data. The German Manufacturing survey was first launched in 1993 and is conducted every two years. In 2003, 1,450 firms returned an utilisable questionnaire. The dataset represents a cross-section of the German manufacturing sectors. By using this large-scale dataset, it is possible to provide the benchmarking firms to choose for a adequate reference group among four categories of firm-size (>50, 50-249, 250-499; 500 or more employees) and seven categories of sector (rubber and plastic products, finished metal products, mechanical engineering, communication

[1] For detailed information see http://www.isi.fhg.de/i/projekte/Fems_e.htm
[2] Some indicators have been complemented by data from the "Mannheim Innovation Panel" (MIP) of the Centre for European Economic Research

engineering, electrical engineering, medical-, optical- and precision engineering, motor vehicles and parts) to gain meaningful benchmarking results.

Presentation and interpretation of the benchmarking results

It is of course important that all benchmarking results are described in a clear, well-structured and comprehensible way. Moreover, we decided to provide three different levels of result description: an overall management summary broken down by input and output indicators, a summary separated by each of the four fields of innovation as well as a detailed analysis for each single indicator. Each time the absolute value of the benchmarking firm is displayed and contrasted with the selected reference group. The benchmarking user is able to see whether the enterprise is doing better or worse than the firms of its comparison group. This way, results are described in different levels of detail and can therefore be used both, for a quick overview and a thorough analysis. Thus, the benchmarking user has the opportunity to gain some insight about the own positioning compared to other firms. The impression of "what the others are doing" might moreover serve as a source of critical analysis of the firm's own innovation behaviour and for further action.

Unlike the majority of innovation benchmarks available on the market, we decided not to provide a single aggregated value of innovation performance. Instead, the benchmarking result should be seen against the individual strategic, comparative and structural background of each firm. As the deployed indicators measure different strategic and resource dimensions of firm-based innovation, they might be targeted to very different paths of firms' innovation behaviour. A aggregated single innovation measure would neglect this heterogeneity and thus only be of little explanatory value.

As the benchmarking SMEs should not be left alone with the interpretation of the results (Ziegele/Hener 2004), it is desirable to mention some first starting-points for further activities and possibilities of improvement, for example by giving some recommendations of possible next steps. Ideally, these are not only identified at the level of single indicators, but also by analysing the interdependencies of these indicators. For example, a high R&D-input that results only in a substandard output with product innovations might be an evidence for an ineffective or inefficient organisation of the firm's product development process. This feature has been considered by implementing some analysis routines across the indicators which identify the most striking inconsistencies between them.

Of course, such recommendations can never substitute a detailed case study of the "real" innovation performance of an enterprise. But they are able to elaborate some main aspects of innovation performance that might still have potential for further improvement. The decision which of these aspects should be addressed by subsequent concrete actions must take into account the firm-specific strategic and structural situation.

VI- Conclusion

Conceptualising an innovation benchmarking tool for the innovativeness of SMEs is a trade-off between theoretical and analytical requirements and practical aspects of feasibility. Certainly, such a self-assessment tool is not able to provide an encompassing and excessively detailed picture of the "real" innovativeness of SMEs. Moreover, it obviously can neither substitute a thorough single case study which considers the whole range of firm-specific aspects nor can it be the basis for elementary strategical (re-)configurations of an enterprise.

But this is not the intended goal of such a tool. The major objective is to offer an easy, cost-saving, and fast methodology that allows SMEs, which otherwise would not deal with the issue of their innovativeness at all, a first-level positioning of their firms in contrast to a selected reference group. Thereby, they are likely to gain some general insights which might be rooms and possibilities for improvement.

References

Acs, Z.J., Audretsch, D.B. (1988) Innovation and firm size in manufacturing. Technovation, 7, 197-210.

Armbruster, H., Kirner, E., Lay, G. (2007) Patterns of Organisational Change in European Industry (PORCH). Ways to strengthen the Empirical Basis of Research and Policy. Luxembourg: Office for Official Publications of the European Industries.

Bandow, G. (1998) Balanced Scorecard und Benchmarking in der Instandhaltung. Kuhn, A. (Hrsg.): Wege zur innovativen Fabrikorganisatin. Band 1. Dortmund: Verlag Praxiswissen, 243-263.

Bea, F. X., Haas, J., (2005) Strategisches Management. 4., neu bearbeite Auflage, Lucius & Lucius, Stuttgart

Becheikh, N., Landry, R., Nabil, A. (2006) Lessons from Innovation Empirical Studies in the Manufacturing Sector: A Systematic Review of the Literature from 1993-2003. In: Technovation, Vol. 26, 644-664.

Bretschneider, M. Stang, R. (2004) Benchmarking in der Weiterbildung. DIE - Reports zur Weiterbildung 12/2004.

Cosh, A., Hughes, A. (2003) Enterprise Challenged. Policy and performance in the British SME sector 1999-2002. Cambridge.

Damanpour, F., (1987) The adoption of technological, administrative and ancillary innovations: Impact of organizational factors. Journal of Management, 13/4, 675-688.

Damanpour, F., Szabat, K.A., Evan, W. M., (1989) The relationship between types of innovation and organizational performance. Journal of Management Studies, 26/6, 587-601.

Dreher, C., Eggers, T., Kinkel, S., Maloca, S. (2005) Gesamtwirtschaftlicher Innovationswettbewerb und betriebliche Innovationsfähigkeit. Bullinger, H. J. (Hrsg.): Fokus Innovation. Kräfte bündeln, Prozesse beschleunigen. Stuttgart, Hanser, 1-28.

Drejer, I., (2004) Identifying innovation in surveys of services: a Schumpeterian perspective. Research Policy, 33, 551-562.

Greenan, N., (2003) Organizational change, technology, employment and skills: an empirical study of French manufacturing. Cambridge Journal of Economics, 27, 287-316.

Grieble, O., Breitling, M., Behrens, H. (2002) Grundsätze und Entwicklungsbegleitende Normung für das Benchmarking öffentlicher Dienstleistungen. Benefit vom 06.10.2002. [http://www.olev.de/b/benchm.htm, last access on 12.06.2008]

Hunziker, P. (2008) Benchmarking – ein bedeutendes Werkzeug. MQ Management und Qualität 3(2008), S. IV-V.

Hipp, C., Grupp, H., (20059 Innovation in the service sector: The demand for service-specific innovation measurement concepts and typologies. Research Policy, 34/4, 517-535.

Kinkel, S., Lay, G., Wengel, J. (2004): Innovation. Mehr als Forschung und Entwicklung. Mitteilungen aus der Produktionsinnovationserhebung Nr. 33, Fraunhofer ISI, Karlsruhe.

Kirner, E., Som, O., Dreher, C., Wiesenmaier, V. (2006) Innovation in KMU. Der ganzheitliche Innovationsansatz und die Bedeutung von Innovationsroutinen für den Innovationsprozess. Karlsruhe, Fraunhofer Institut für System- und Innovationsforschung.

Lam, A., (2005) Organisational innovation, in: Fagerberg, J., Mowery, D.C., Nelson, R.R. (Eds.), The Oxford Handbook of Innovation. Oxford University Press, Oxford, pp. 115-147.

Legner, C., Österle, H. (1999): Prozessbenchmarking - Ein methodischer Ansatz zur Prozess-entwicklung mit Standardsoftware, in: Scheer, A.-W. und Nüttgens, M. (Hrsg.), Electronic Business Engineering, Heidelberg, 331-352.

Mertens, K. (2006) Benchmarking. Leitfaden für den Vergleich mit den Besten. Symposion Publishing GmbH.

OECD (2005) Oslo Manual - Guidelines for Collecting and Interpreting Innovation Data. 3rd edition, Paris.

Porter, M. E. (1996) What Is Strategy? In: Harvard Business Review, Boston.

Puschmann, T. Alt, R. (2002) Benchmarking Customer Relationship Management. Universität St. Gallen: Bericht-Nr. BE HSG/CC BN/ 21.

Schumpeter, J.A., (1934) The theory of economic development. Harvard University Press, Cambridge Massachusetts.

Smith, K. (2005) Measuring innovation, Fagerberg, J., Mowery, D.C., Nelson, R.R. (Eds.), The Oxford Handbook of Innovation, pp. 148-177. Oxford University Press, Oxford.

Stocker, P.O. (2007) Benchmarking: Von den Besten lernen. In: KMU-Magazin Nr. 1, 40-42.

Straub, R. (1997) Benchmarking, Eine Darstellung des Benchmarking als modernes Instrument der Leistungsverbesserung, Dissertation der Wirtschaftswissenschaftlichen Fakultät der Universität Zürich 1997.

Tidd, J., Bessant, J., Pavitt, K. (2005): Managing Innovation: Integrating technological, market and organizational change. 3rd edition, Chichester, John Wiley & Sons.

Totterdell, P., Leach, D., Birdi, K., Clegg, C., Wall, T. (2002) An investigation of the contents and consequences of major organizational innovations. International Journal of Innovation Management, 6/4, 343-368.

Vahs, D., Burmester, R. (2002): Innovationsmanagement. Von der Produktidee zur erfolgreichen Vermarktung. 2. über-arbeitete Auflage, Stuttgart.

Vossen, R. W. (1998) Relative strengths and weaknesses of small firms in innovation. International Small Business Journal, 16(3), 88-94.

Watson, G. H. (1993) *Benchmarking – vom Besten lernen*, Landsberg/Lech.

Westkämper, E., Mai, C., Kaumanns, W. (1998) Umfassendes Qualitätsmanagement in kleinen und mittleren Unternehmen. Eine empirische Studie. Stuttgart, Fraunhofer Institut für Produktionstechnik und Automatisierung, IRB-Verlag.

Wheelwright, S. C., Clark, K. B. (1992) Revolutionizing Product Development. Quantum Leaps in Speed, Efficiency, and Quality. Maxwell Macmillan International, Free Press.

Zdrowomyslaw, N., Kasch, R. (2002) Betriebsvergleiche und Benchmarking für die Managementpraxis. Unternehmensanalyse, Unternehmenstransparenz und Motivation durch Kenn- und Vergleichsgrößen. Oldenbourg Wissenschaftsverlag.

Ziegele, F., Hener, Y. (2004) Benchmarking in der Hochschulpraxis. Benz, W. et al. (Hrsg.): Handbuch Qualität in Studium und Lehre, E7.2, Berlin.

Technology standard diffusion and negative network externalities: a lesson from the third Browser War

Andrea Ventura, Giovanni Perrone*, Umberto La Commare

DTMPIG, Università di Palermo, Palermo, ITALY

* Corresponding author: gioperro@dtpm.unipa.it, Viale delle Scienze, Ed. 8, 90128, Palermo

Abstract: This paper presents a new model for technology standard diffusion that highlights the importance of negative network externalities in some fields of technology product such as web browsers. Again, as often happened in this research field, motivation and suggestion for such a research has been acquired from the evolution of the web browser war. So, in the paper, the main literature concerning standard diffusion has been reviewed in conjunction with web browser evolution, and the necessity of a new development of technology standard diffusion models is highlighted and supported by empirical evidences.

Keywords: Standards diffusion, Lock-in, Web Browser

I- Introduction

The browser war has been a widely investigated testbed for technology standard diffusion models. Indeed, several authors have addressed the way in which commercial standards spread and affirm themselves in the market. Several case studies in literature have been analysed; perhaps, before the browser war, the most known are those concerning the battle between the QWERTY and DVORAK keyboards (David, 1985) and Sony Betamax vs. JVC VHS. These cases put some remarkable verification on the main theory of standard diffusion, accordingly to that a new technology affirms itself if:

a) it is superior respect to the old technology;

b) it is more price competitive;

c) the developer enjoys a distribution or advertising advantages (Windrum, 2004).

Mostly, they have raised some questions about the possibility of some sub-optimal technology to spread and affirm in the market. Especially the supremacy of the QWERTY keyboard against the DVORAK's one, is a clear case of a sub-optimal technology that affirms itself against a more performing one.

Arthur in 1983 (Arthur, 1983) was the first researcher to develop a model able to provide quantitative estimation of technology standard diffusion. The first model developed by Arthur was simply a random walk with absorbing barriers. Furthermore, the same author together with Ermoliev and Kaniovski (Arthur et al., 1983, 1987) developed a modified Polya Urn model, while again Arthur in 1986 developed a third model again based on a 45°random walk. However, the most referred Arthur model, known also as Lock-in, is the Polya Urn one; the Arthur's Lock-in model provides at least two relevant issues about technology diffusion process. First, if network externalities are positive (bandwagon effect) the technology adoption process will converge on a dominance of a single technology with probability equal to 1. This is the result of the so called AEK Strong Law, that can be demonstrated by the modified Polya Urn Arthur's model. Secondly it is not possible to foresee a priori which one will be the dominant technology; indeed, since the adopters choice is interdependent, the selection is not-ergodic and highly dependent on starting conditions.

The browser war was a great testbed for the Arthur's model. Indeed, the first browser war, that between Mosaic and Netscape, is well interpreted by the Arthur's model. However, as noticed by Windrum (Windrum, 2000), it is not good to explain why Microsoft won the second browser war against Netscape. Therefore, Windrum modified the Arthur's Lock-in model to take into account for "linked-markets" and the price strategy adopted by Microsoft and, thus, he successfully faced the second browser war.

So, we arrive at the third browser war, the one Microsoft IE is playing against Mozilla Firefox, and eventually against Safari. Again, the Windrum's modified Lock-in model does not seem able to explain why Firefox is recovering market shares so fast against Microsoft IE. Our hypothesis is that the Windrum's Lock-in models does not takes into account for negative network externalities coming from browser attack and security cost. So, in this paper, we have developed a modified Lock-in model that, for the first time, takes into account for negative network externalities in technology standard diffusion.

The remainder of the paper is organized as it follows: paragraph 2, briefly describes the three acts of browser war; in paragraph 3, the evolution of the Arthur's model are discussed and the proposed model is presented. Finally, in sections 4 and 5, some results of the application of the proposed model at the third act of the browser war are discussed and conclusions are drawn.

II- The browser war: three acts

The first act of the browser war was the dispute between Mosaic and Netscape. Mosaic was the first commercial browser developed by Marc Andreessen and Eric Bina at the National Center for Supercomputing Applications (NCSA) in 1992. The commercial release of Mosaic was launched in 1993; Mosaic was a multiplatform graphical web browser supporting images, e-mail and other services. Mosaic, as an innovator, became the leader in the web browser market. But its leadership did not last long. Indeed, in 1994, Marc Andreessen joined Jim Clark and they founded a new company called Netscape. Netscape, at the beginning was a distributor of a commercial software called Mosaic Netscape, licensed by Spyglass Mosaic, the firm that acquired licence and brand of Mosaic from NCSA. Because of a dispute between Netscape and Spyglass, Netscape decided to develop a new web browser, completely different from Mosaic, called Netscape Navigator. The first release of Netscape Navigator was released in October 1994. It was a software technically superior of Mosaic; it was ten times faster in loading pages and it was enriched of features that allowed web publishers to create more attractive and performing web pages. Netscape Navigator easily killed Mosaic and in August 1995, Netscape reached the 90% of the web browser market share. Netscape won its dispute against Mosaic thanks to two strategies:

a) it was a more performing product;

b) it applied a novel price strategy.

Indeed, Netscape Navigator was downloadable for free for user consumers, while it had a cost for developers and corporations. According to the main stream theory of technology standard diffusion, such a strategy allowed Netscape to replace Mosaic.

Very different is the second act in the browser war, the one involving Microsoft. Microsoft became interested in the Internet market after the historical "Pearl Harbor" speech of Bill Gates. In that speech, Gates affirmed that Internet was a central issue in the Microsoft development strategy. Up that time Microsoft had released Internet Explorer (IE) 1.0 and 2.0, both as licensed versions of NCSA Mosaic. After the change in Microsoft strategy, IE 3.0 and IE 4.0 were released. It is widely recognised that both the last versions were products technologically inferior of Netscape 2.0. Indeed, we need to wait until March 1999, with the release of IE 5.0, to gain a product comparable with Netscape Navigator 2.0. But, as depicted in Figure 1, in 1999 Netscape, whose market share dropped to less than 20%, had almost lost the war. How? Indeed, it was not because of the products, since, as said, IE 3.0 and 4.0 were technologically

inferior of Netscape Navigator 2.0; neither it was because of the price strategy, since, basically, Microsoft adopted the same price strategy of Netscape, by releasing IE for free. Then? As it was discussed in many papers, (Spinello, 2005) and within the DoJ rooms, the Microsoft's success in the second browser war was basically due to: a) the tying strategy Microsoft adopted; indeed, by bundling IE to the Microsoft Windows operating system, Microsoft used the Microsoft Windows installed base to boost IE adoption and accelerating related positive network externalities; b) the control of distribution channels; indeed, Microsoft used its market power over the PC retail and the Internet Service Providers (ISP) markets to ensure that IE and not Netscape Navigator, was the first browser users would come into contact with. By matching these two strategies, Microsoft won the second browser war.

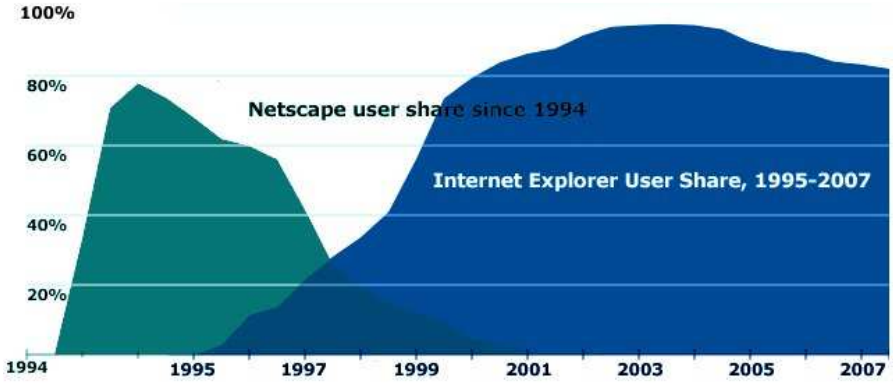


Figure 1. Microsoft IE vs. Netscape Navigator market shares

Here we come to the third act of the browser war. Before the successful take-over of American Online over Netscape, the company released under an opensource strategy the original code of Netscape. In 1998 the Mozilla Organisation was constituted as a consortium whose objective was to develop an Open Netscape. When AOL left the consortium, the Mozilla Organisation transformed itself in the Mozilla Foundation, a no-profit organisation whose objective was to promote the opensource browser Mozilla. In November 2004, the first release of Mozilla Firefox 1.0 was released and it received 10 million of downloads in a month. Between the November 2004 and the first trimester of 2006, the battle in the browser field has been between Mozilla Firefox 1.0 and 1.5 and IE 6.0. Afterwards, Mozilla Firefox 2.0 and IE 7.0 were released. Mozilla Firefox is a multiplatform open source web browser that has been developed in accordance with the World Wide Web Consortium (3C).

Initially, Mozilla Firefox was considered less vulnerable against Internet attacks than IE 6.0, who, instead, was considered very vulnerable. The security issues has been improved a lot with IE 7.0, whose security standard can be comparable to Mozilla Firefox 2.0. However, IE 7.0 does not meet yet the W3C standards, that, on the other hand, are already satisfied by Mozilla 2.0. In any case, as depicted in Figure 2, Mozilla Firefox, has increased its market share from 3% to almost 15% in 4 years, while Microsoft IE has lost something like a 10% of market share. How? Yes, Mozilla 1.0, was initially a superior product in term of security regards to IE 6.0. But, no price strategy advantage has been played by Mozilla Foundation, since Firefox is released a zero cost for the users as IE. Also, IE recovered very soon its security problem, since in early 2006, Microsoft released a product not inferior of Mozilla Firefox 2.0. So why IE is still losing market shares? IE is still paying negative network externalities due to being the most popular web browser. Indeed, Internet attacks are mostly developed for popular applications and they hurt more less "skilled" users. IE is still the most spread web browser and, compared to Mozilla Firefox, as it is well known, it is used by less skilled users than Mozilla Firefox.

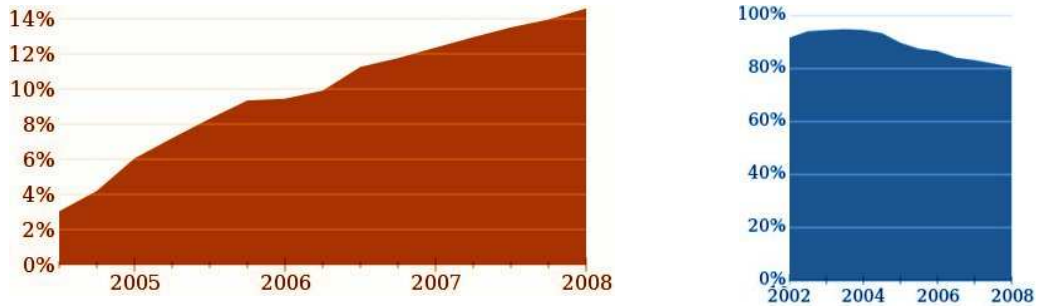


Figure 2. Mozilla Firefox market share (red) vs. Microsoft IE's one (blue)

III- Models for standard diffusion

The Arthur's model can be easily explained by referring to an individual choice between two substituting technologies. The individual decision is made by maximising the payoff associated to each technology variant; the payoff at the time *t* is given by the following expression:

$$\pi_i(t) = X_{ij} + r(n_j(t)) \qquad (1)$$

being

$\pi_i(t)$, the payoff of the decision maker *i* at time *t*,

X_{ij} the hedonistic preference *i* accords to the technology *j*, and

r() a function expressing the positive network externalities related with the number of the adopters of technology *j* at time *t*, $n_j(t)$.

As said before, as *r()* increases with n_j, the probability that the process converge to a single technology is 1 (lock-in property). Also, since individual choice are casual and interdependent, it is not possible to predict, ex ante, which technology will dominate the other. This well explain how also sub-optimal technologies can affirm themselves in the market.

The model in (1) well explains the first browser war: Netscape was a superior technology regards to Mosaic and, as previously discussed, it had a price advantage (it was given for free to the individual users), so that the individual preference term *X* in (1) was strongly in support of Netscape. Also, even if Mosaic had a bigger market share at the beginning, the Internet market was growing so fast that the initial number of adopters of Mosaic did not represent a real network externalities advantage for Mosaic. So, accordingly to model in (1) Netscape won.

However, equation (1) it is not able to explain the second browser war. Indeed, at the beginning Netscape was a superior product respect to IE, and no price advantages were available for IE, given that Microsoft played the same price strategy of Netscape; therefore, the individual preference *X* in (1) was actually in support of Netscape. Furthermore, Netscape had strong advantages in term of number of adopters, even if, as above, the Internet market was growing at very fast rates, making this advantage weak.

By underlying such a limitations, Windrum (Windrum, 2000) suggested to modify the Arthur's model as it follows:

$$\pi_i(t) = X_{ij} + r(n_j(t) + n_k(t)) - (I_j + P_j) \quad (2)$$

where, $n_k(t)$ is the number of adopters of a linked technology *k*.

In the specific case, Microsoft by tying IE with Microsoft Windows, enlarged the number of adopters to the Microsoft Windows users empowering the network externalities factor.

On the other hand, I_j is the set-up cost users need to sustain to adopt the technology *j*; this cost was zero for Microsoft IE adopters, since, thanks to the Microsoft controls over the distribution channels, IE was preinstalled into Microsoft Windows, at least for the n_k users; while, was not zero for the Netscape Navigator adopters since they had to download and to install it.

Finally, P_j is the monetary cost needed to acquire the technology *j*. Also in this case, Microsoft had an advantage, since it released for free IE also to Internet developers. Therefore, the Windrum's model as in (2) is able to explain the second browser war.

But, again, it is not able to explain why Mozilla Firefox is recovering so fast against IE. Indeed, accordingly to Windrum's model, IE has still a set-up cost advantage over Mozilla Firefox, since this last browser is to be downloaded and installed from the Internet. So, why is Mozilla Firefox recovering market share so fast? In our opinion this is because of the security costs and the negative externalities related to security issues.

Indeed, Internet attacks are deployed especially for the most popular web browser, i.e. IE. This is because IE reaches the great part of the e-commerce users. So more skilled users, those who are informed about risks, prefer to face higher set-up cost and download a less attacked and, perhaps at the beginning, safer browser, i.e. Mozilla Firefox. Also, Internet is now a more mature market in which consumers become more consciousness and informed. Especially those who make an experience of Internet security problem, become more informed about and, in some sense, more skilled, so that they understand basic concept of web browser security. This is another limitation of the Windrum's modified Arthur's model: it does not consider security cost and does not discern among skilled and no-skilled users. Finally, another issue to be consider in a more mature market, is the compatibility with standards such as the W3C, which is again more important for skilled users. In order to take into account for such issues, we propose to modify the Windrum's model as it follows.

$$\pi_i(t) = X_{ij} + r_i\left(\frac{n_j(t)}{N}\right) - c_i\left(\frac{n_j(t)}{N}\right) - (I_{ij} + P_{ij} + W_{ij} + S_{ij}) \quad (3)$$

As the reader can notice in (3),

r() is the positive network externality function, that in our model is related to the technology market share, n_j/N, while

c() is the negative network externality factor, that takes into account for security problem related with the diffusion of the browser technology; also this factor is related to market share.

Also, both *r()* and *c()* are not the same for all the users; they depend on the typology of the user *i*.

Besides, the coefficient *W* and *S* have been added; *W* takes into account for costs to be paid for not following standard such the W3C, while *S* takes into account for security costs. Also such parameters are users dependent.

IV- Experimental results

The model proposed in (3) has been implemented and simulated in order to see whether it is able to foresee the third browser war between Microsoft IE and Mozilla Firefox. The general formulation exhibited in (3) has been specified as it follows:

$$\pi_i(t) = X_{ij} + E_i^+ \cdot \frac{n_j(t)}{N} - E_i^- \cdot \left(\frac{n_j(t)}{N}\right)^2 - (I_{ij} + P_{ij} + W_{ij} + S_{ij}) \qquad (4)$$

where, the positive network externalities function is linear with a factor E^+; on the other hand, the negative network externalities function is quadratic with a factor E^-; the reason why a quadratic function has been chosen in this case, is that the higher is the market share the more significant this factor is; vice versa, when market share is low this factor becomes scarcely significant.

We have assumed two kind of users: A, not experienced users; B, experienced users. We have simulated the adoption process for Microsoft IE and Mozilla Firefox (Mf) by using the (4) from 2000, T_{00}, to 2008, T_{08}, with the data depicted in Table 1.

As the reader can notice, positive network externalities are more significant for not experienced users, while negative externalities are more important for experienced users. Set-up costs, *I*, are less significant for IE users, while are greater for Mf users, especially for not experienced users. Compatibility costs, *W*, are more significant for IE, especially for expert users; however, these costs reduce over the years since IE has improved compatibility performance. Security cost, *S*, are perceived as high from experienced users using IE; also this cost reduces over time. Price, *P*, are assumed 0 for both the technology. Individual preference, *X*, for Microsoft IE is higher for not experienced users, while, experienced users prefer Mf. Finally, we have assumed a 90% of not experienced users at T_{00}, and a 60% in T_{08}.

	E_A^+	E_B^+	E_A^-	E_B^-	$I_{A,IE}$	$I_{B,IE}$	$I_{A,Mf}$	$I_{B,Mf}$	$W_{A,IE}$	$W_{B,IE}$	$W_{A,Mf}$	$W_{B,Mf}$
T_{00}	18	12	2	6	0	0	10	6	8	10	1	1
T_{08}	14	10	2	6	3	3	5	2	3	3	1	3
	$S_{A,IE}$	$S_{B,IE}$	$S_{A,Mf}$	$S_{B,Mf}$	$X_{A,IE}$	$X_{B,IE}$	$X_{A,Mf}$	$X_{B,Mf}$	%A	%B		
T_{00}	10	15	10	5	14	8	8	12	90	10		
T_{08}	3	5	3	3					60	40		

Table 1. Simulation data

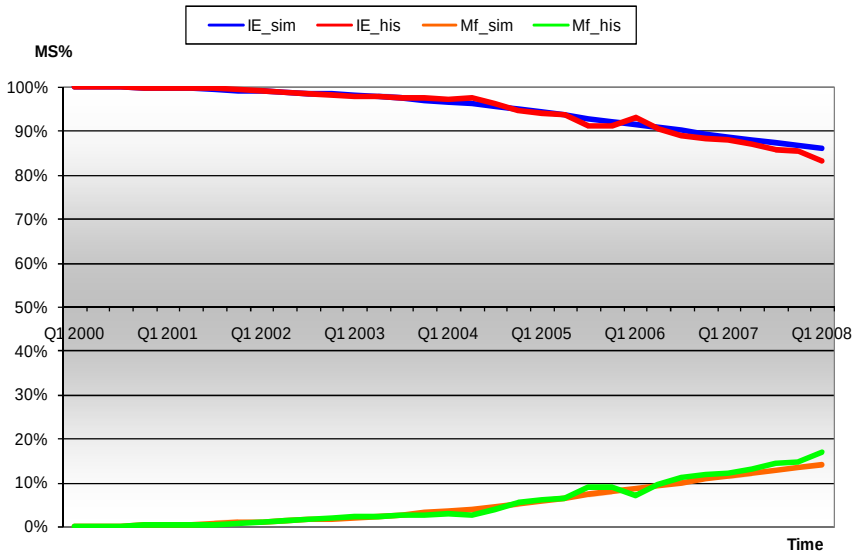


Figure 3. Simulation results

We have conducted 10.000 steps of simulation in which each user makes its own decision based on the expression (4). In Figure 3 we have reported the historical data related to Microsoft IE and Mozilla Firefox market shares, respectively *IE_his* and *Mf_his*. On the other hand, in the same chart, the result of our simulation have been reported; in particular, *IE_sim*, is the number of adopters of IE according to our model, while *Mf_sim* is the number of adopters of Mozilla Firefox. As the reader can notice by observing Figure 3, our model well interpret the historical data.

We have also conducted a robustness analysis over the parameters of model (4) and we have got sounding results supporting the validity of our model. In particular:

- If the rate between not experienced users and experienced one does not change, the adoption of Mf would be slower than the real numbers suggest;
- If the coefficient of the positive networks externalities increases, the adoption of Mf slows down;
- On the other hand, if the impact of the negative externalities increases, the adoption of Mf speeds up.

V- Conclusions

This paper critically analyzes the most recent literature on technology standards adoption and diffusion. In particular, the most important analytical models due to Arthur and Windrum have been reviewed under new data collected from the third browser war, the one between Windows IE and Mozilla Firefox.

Up to now, those models have rightly highlighted the influence of positive network externalities on technology standard diffusion. Windrum, in particular, has highlighted how positive network externalities can be also related to linked technologies. In our opinion, the third browser war introduces the influence of negative networks externalities on technology standard diffusion. In case of web browser, negative networks externalities are related to Internet attacks who mostly hurt the most spread web browser, that is Windows IE. Thus, more skilled used prefer to use a

safer and less popular web browser like Mozilla Firefox. Such an intuition has been applied to modify the Arthur-Windrow's model for technology standard diffusion. Our simulation seems to confirm such an intuition; indeed, the modified model, is able to predict real data on web browser market shares dynamics. Also, a robustness analysis over the parameter of the proposed model seems to support how negative networks externalities and related costs can effect standard diffusion.

References

Arthur, W.B., 1983, Competing technologies and lock-in by historical events: the dynamics of allocation under increasing returns, IIASA Working Paper, WP-83-90-, Laxemburg: Austria.

Arthur, W.B., Ermoliev, Y. M. and Kaniovski, Y.M., 1983, Strong laws for a class of path dependent urn processes, in Arkin, Shirayayev and Wets (eds.), Proceedings of the International Conference on Stochastic Optimization, Kiev 1984, Springer: Berlin.

Arthur, W.B., Ermoliev, Y.M., Kaniovski, Y.M., 1987. Path dependent processes and the emergence of macrostructure. European Journal of Operational Research 30, 294–303.

Cusumano, M.A., Yoffie, D.B., 1998. Competing on Internet Time: Lessons from Netscape and Its Battle with Microsoft. Free Press, New York.

David, P.A., 1985. Clio and the economics of QWERTY. American Economic Review 75, 332–336.

Spinello R. A., 2005, Competing Fairly in the New Economy: Lessons from the Browser Wars, Journal of Business Ethics, 57: 343–361.

Windrum Paul, 2000, Back from the brink: Microsoft and the strategic use of standards in the Browser Wars, SEIN Paper.

Windrum Paul, 2004, Leveraging technological externalities in complex technologies: Microsoft's exploitation of standards in the browser wars, Research Policy 33: 385–394.

Serious Gaming for End-User Requirements Identification in Innovation Projects

H. Duin[1,*], J. Baalsrud Hauge[1], F. Hunecker[1], K.-D. Thoben[1]

[1] BIBA – Bremer Institut für Produktion und Logistik GmbH, 28359 Bremen, Gerrnay

* Corresponding author: du@biba.uni-bremen.de, +49 421 218-5540

Abstract: This paper presents an approach taken to identify end-user requirements for innovations in the area of enterprise interoperability and collaborative services in enterprise networks. The approach is based on serious gaming. Six end-user organisations participated in a workshop, where two specific games were played. The first game aimed for demonstrating needs in collaboration, and the second game supported the ideation process for generating requirements for innovative services. Finally, an evaluation of the games by the end-users is presented.

Keywords: User Requirements Analysis, Serious Gaming, Innovation in Enterprise Operability and Collaboration

I- Introduction

The identification and analysis of end-user requirements is part of the first steps in an innovation development project. Traditional methods of requirements engineering include business process analysis, questionnaires, interviews, etc. (e.g. Hull et al 2005). One problem in such an approach is that end-users do not anticipate the whole potential of the innovative product (or service) to be developed. This is because no attempt is undertaken to construct a scenario allowing them to anticipate futuristic and innovative functionality. Often, end-users come up with conservative requirements which are in most cases already known.

The European Integrated Project COIN (Enterprise Collaboration and Interoperability) follows the vision: "*By 2020 enterprise collaboration and interoperability services will become an invisible, pervasive and self-adaptive knowledge and business utility at disposal of the European networked enterprises from any industrial sector and domain in order to rapidly set-up, efficiently manage and effectively operate different forms of business collaborations, from the most traditionally supply chains to the most advanced and dynamic business ecosystems. By 2020 enterprise collaboration and interoperability services will become an invisible, pervasive and self-adaptive knowledge and business utility at disposal of the European networked enterprises from any industrial sector and domain in order to rapidly set-up, efficiently manage and effectively operate different forms of business collaborations, from the most traditionally supply chains to the most advanced and dynamic business ecosystems.*" (taken from www.coin-ip.eu)

The realisation of such a vision has the need to identify quite innovative requirements as early as possible. For such a task creativity techniques are useful, e.g. Schlosser et al (2008) used creativity workshops. Here, an approach using serious gaming is presented. A workshop with six end-user organisations has been organised to work on the requirements (most of them are a kind of an enterprise network like industrial clusters). The two main objectives of the workshop were:

- To assess and verify the validity of already known requirements covering so-called baseline services for enterprise networks.
- To identify new requirements for new and innovative enterprise interoperability and collaboration services.

II- Approach

To provide to the end-users a constructivist approach to anticipate innovative (future) requirements, a non-traditional approach by applying serious gaming has been chosen. Two games have been chosen to support (1) gaming future scenarios where the players are responsible to define and implement a supply chain for a specific product (the game SECONDS has been applied), and (2) a game that supports ideation and therefore the creation of novel ideas, i.e. new requirements for innovative services (the game *refQuest*).

Prior to the workshop some typical business cases have been collected in order to adapt the games as much as possible to the known business environment of the end-users.

Description of SECONDS

The game SECONDS aims at supporting users to play by making strategic decisions within the scope of collaborative manufacturing. The game is based on a generic process model (Hunecker 2008) and a simulation engine providing a complex virtual business environment. Each player takes over a role in an organisation defined in the game, establishes sites, buys buildings, defines departments and controls processes. To stand a chance in the competitive game environment, the player has to find business partners, has to communicate and negotiate with them. He has to analyze risks and opportunities, has to assess strategies and take risky decisions. The game features a role based model where the players can take any role in any organization. Players of different degrees can play together and bring in their competencies. Figure 2 shows two screenshots of the user interface of SECONDS.

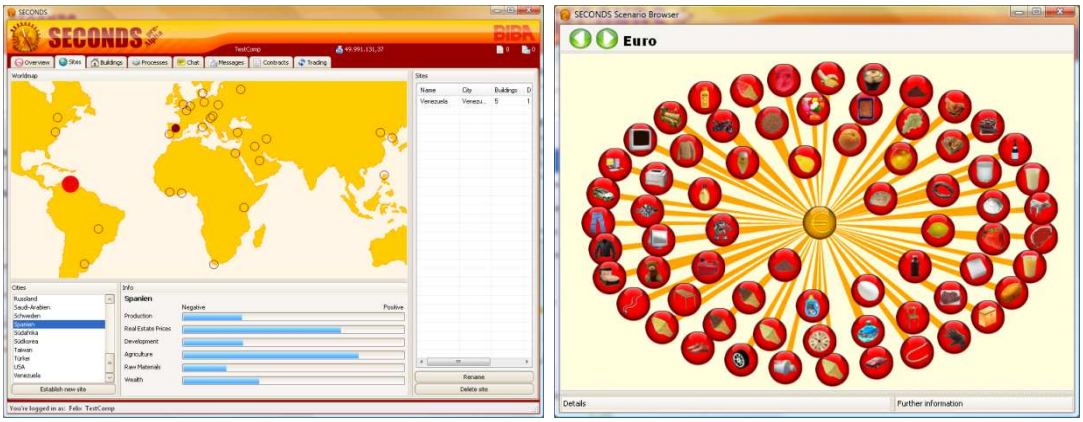


Figure 2: Screenshots of Game SECONDS

In preparation of the workshop, the companies of the participating end users were mapped into a common game scenario. The end users got a site that matched their particular company location and got a factory with all needed resources to be able to produce car parts.

The game features a chat and a mail function to support the communication between the users. But they can also use any kind of communication technology, like phone or video conferencing, they want. The users can negotiate contracts and trade products between each other. The scenario was set up in a way to force the players to communicate and to collaborate with each other. The mission of the users was to establish a virtual organization that is producing a car. This product was chosen because its complexity is high enough to justify a collaborative production, but nevertheless is easy understandable, as most users have a general technical understanding of a cars components. Using more innovative products like mobile phones or IT-Technology would probably result in difficulties among the players to obtain a common discussion basis. Although none of the end users was in any sort operative in the car production industry, all of them were able to understand the processes and the resources used in the car production.

From the perspective of requirement gathering the aim of the game was to face the end users with the problems of collaboration. While playing the game, they were dealing with the problems of internal and external communication, allocation of responsibilities and the search for partners that have the demanded competencies. During the game, the players were forced to build a virtual organization. This was done in four phases, namely preparation, initialization, operation and dissolution. Each of these four phases took approximately two hours. Between the phases, brainstorming sessions were held to collect and fix the ideas for new requirements.

Description of *refQuest*

refQuest is a game developed to support the ideation process in innovation projects (Duin et al 2008). It is part of the Laboranova software tool box developed by the European Integrated Project Laboranova (e.g. Hesmer et al 2007).

refQuest is based on an gaming engine allowing multiple players to execute a distributed business process composed of action applications and completing documents. The course of the game is monitored by a facilitator who can intervene by setting events for the players. Based on the structure of the COIN project, i.e. baseline services and innovative services, three scenarios have been implemented: (1) requirements for baseline services, (2) requirements for innovative collaboration services, and (3) requirements for innovative enterprise interoperability services.

During the course of each scenario the players have to choose a specific perspective by choosing between organisation, technology and business process perspective. Then the players are encouraged to generate personal ideas (requirements) and to document them in a specific document. After this a round of common idea generation by presenting and discussing the personal ideas is performed and followed by a ranking. This process is done for several topics, e.g. new product development, collaborative manufacturing and multi-disciplinary project management. Because of the amount of topics, the end-users continued to play the *refQuest* game for four weeks after the workshop at appointed dates. Figure 3 shows two screenshots of the gaming interface of *refQuest*.

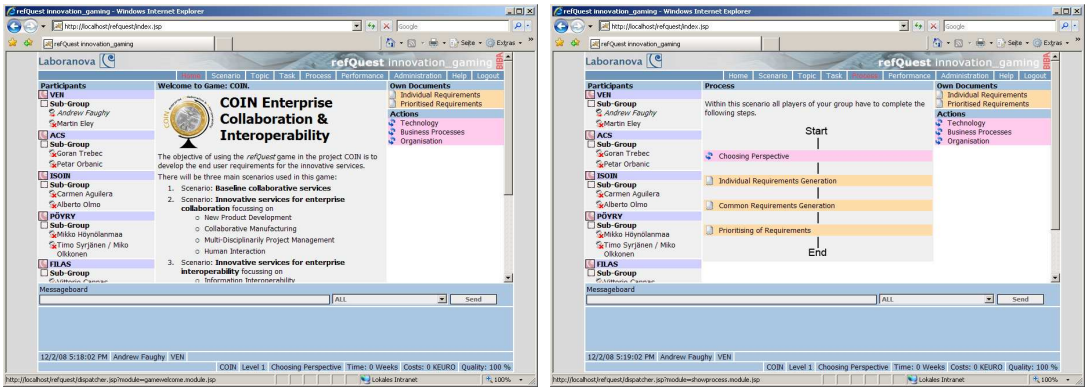


Figure 3: Screenshots of Game *refQuest*

The workshop ran over three days with introductory sessions to the topics, to the games beside the gaming activities. After playing each game, a moderated round took place to capture and discuss the main requirements identified so far.

Execution of the Workshop

The workshop took place during three days in the beginning of June 2008. It started on the first day at noon and ended on the third day early afternoon. An agenda is given in Table 2.

Beside the gaming sessions the workshop also included introductory sessions and reflection and evaluation sessions. The introductions were used to explain the rules of the games and to answer questions raised by the participants. The reflective sessions were used to summarise

identified requirements and to discuss them in the group. The evaluation sessions focussed on the games capturing pros and cons and getting an evaluation of the usefulness of the games.

Day 1	**Day 2**	**Day 3**
	Introduction of Day 2	Introduction of Day 3
	Playing the SECONDS Game	Playing *refQuest* Game
	Reflective Session	Reflective Session
	Playing the SECONDS Game	Playing *refQuest* Game
Introduction to the Workshop	Evaluation Session	Evaluation Session
Introduction to SECONDS	Introduction to *refQuest*	
Playing the SECONDS Game	Playing the *refQuest* Game	

Table 2: Agenda of the Workshop

Figure 4 shows the end users while performing a gaming session. The left side of the photo shows the partition walls on which feedback on the games and some initial requirements have been collected (reflection and evaluation sessions).

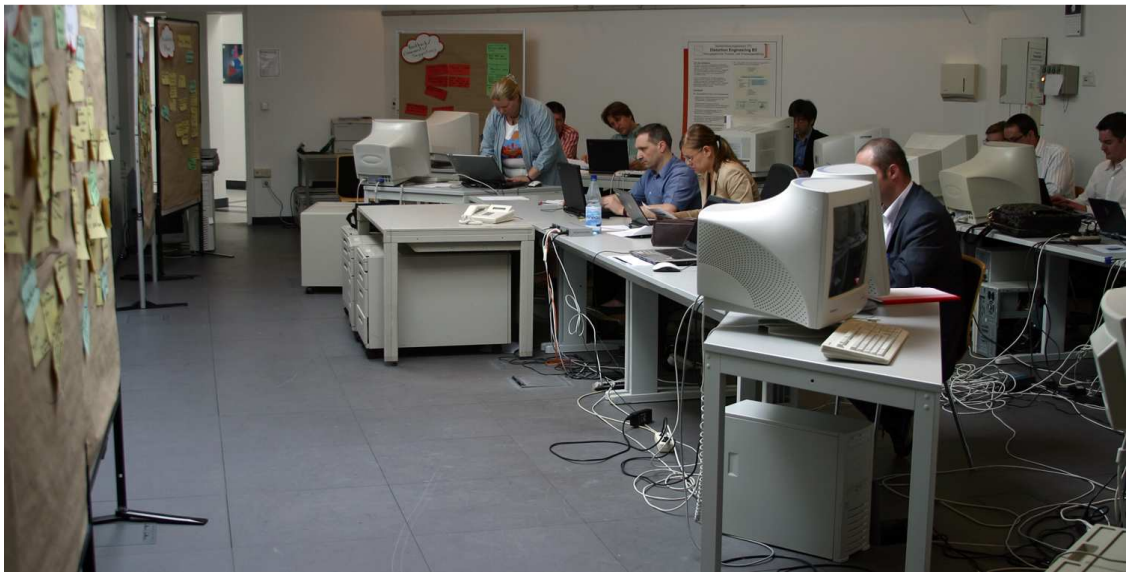


Figure 4: End Users Performing a Gaming Session at the COIN Workshop

The method used for the reflection and evaluation sessions is called (in German) Metaplan- or Moderationstechnik (Claussen et al, 1996). The main idea behind this technique is that the participants prepare short answers to specific questions on a small piece of paper. These are then collected and pinned to a board moderated by an external (non-player) moderator who leads the discussion of the answers. An example for such a board is given in Figure 5. In the evaluation sessions additionally questionnaires have been used.

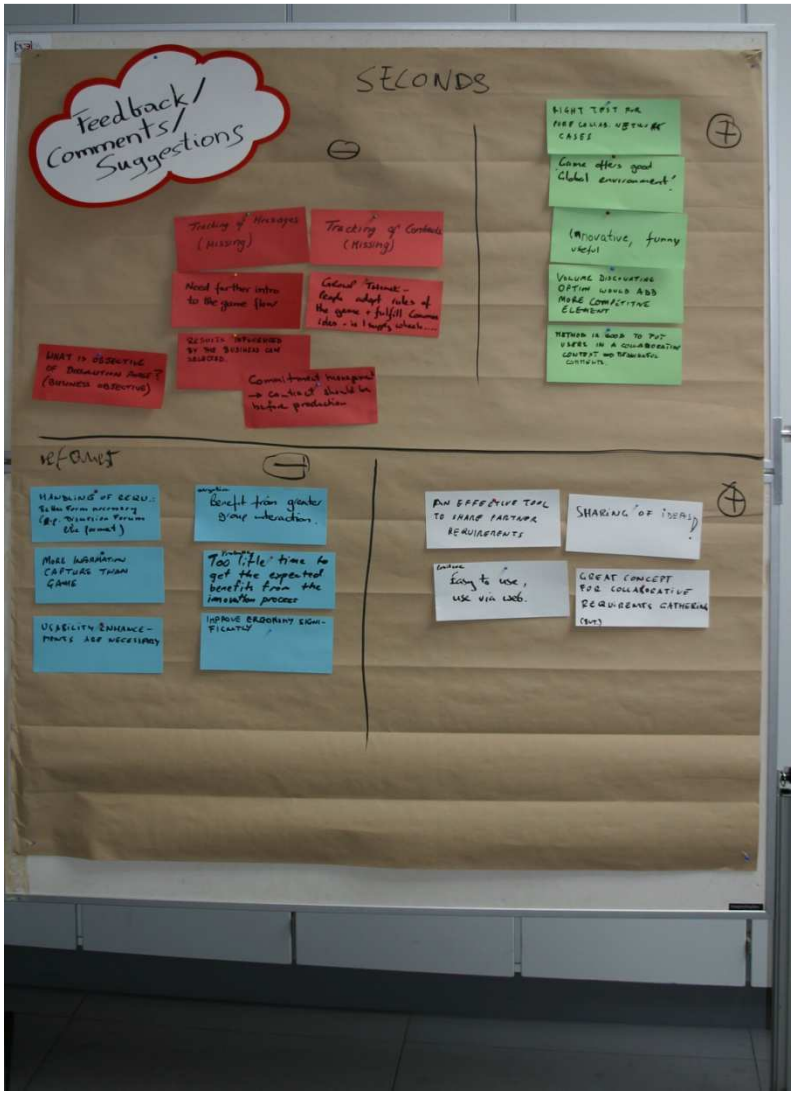


Figure 5: A Board with Evaluation Results for the Game SECONDS

III- Evaluation

During the workshop a questionnaire was distributed to the participants to gather feedback on the requirements gathering approach using gaming. In total, twelve questionnaires have been collected. The questionnaire included several questions to be answered on a scale from one to seven. Example questions are:

During the game …

- … I was very motivated
- … I did feel comfortable
- … I did have enough time
- … the tasks to be solved were easily understandable
- … the structure of the game was easily understandable

Figure 6 provides the averaged answers of the participants to the questions above. All results are higher than 3.5 which represent the neutral median of the scale.

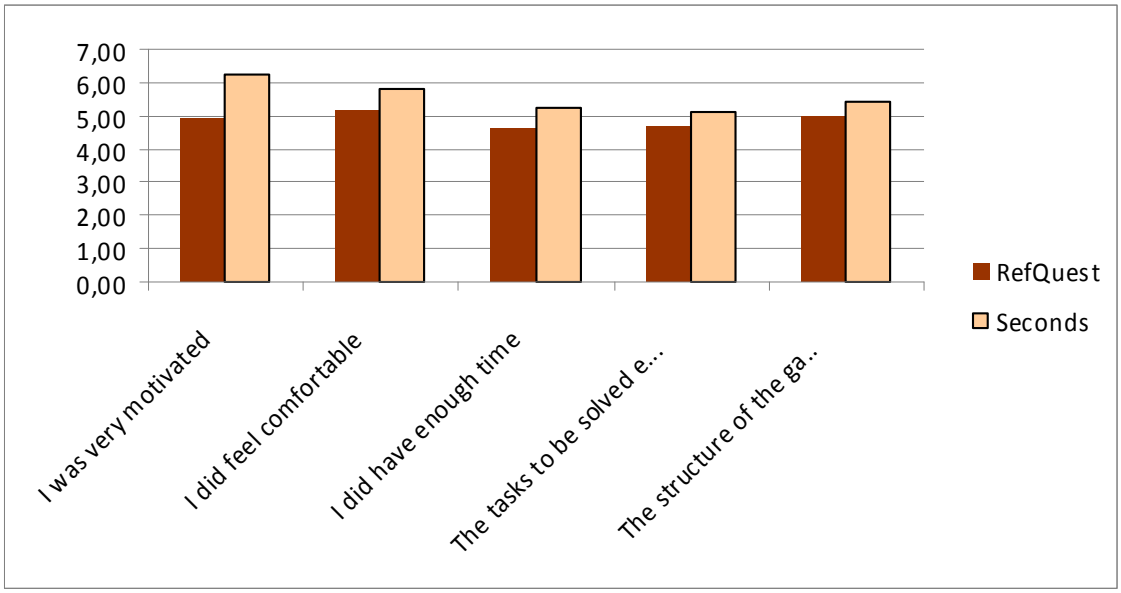


Figure 6: Evaluation Results for *refQuest* and SECONDS

Another set of questions focussed directly the game and the gameplay, e.g.

The game is …

- … too long
- … very usable

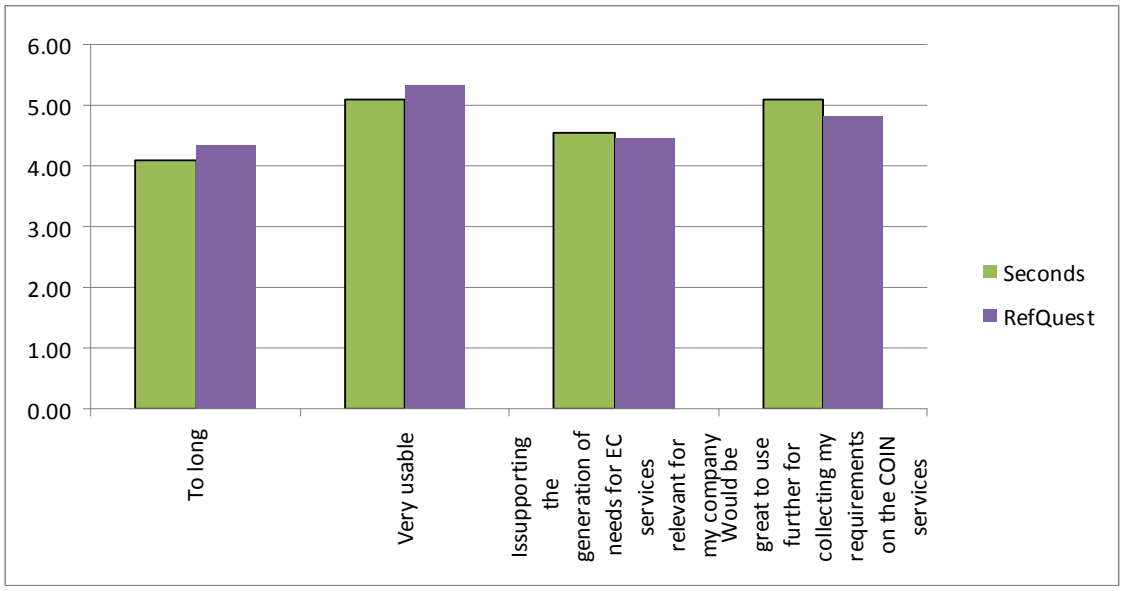


Figure 7: Further Evaluation Results for *refQuest* and SECONDS

- … supporting the generation of needs for Enterprise Collaboration services
- … of great use for further collecting requirements in the COIN project

Figure 7 provides the results for this set of questions and again, for both games the answers range above the median of 3.5. The evaluation sessions and some informal interviews with a few of the workshop participants led further to some lessons learned during the execution of the workshop, e.g.:

- Both games SECONDS and *refQuest* need to be highly configurable to adapt to the situations found in the sector and in the enterprises of the end-users.
- The *refQuest* game needs to be set-up in such a way that it supports the end-users in formulating precise requirements in the form of "The system should provide …".
- The output of the refQuest game is a XML file, which collects the content of the business process and associated actions, events, and documents. This output is too generic for an analyst who is concerned with further analysis of the results.

IV- Conclusions and Outlook

The evaluation of the approach of using serious games on a requirements identification workshop shows that this new idea is promising. Especially playing SECONDS supported the participants in overcoming quite fast some psychological barriers. The participants conceived themselves as a homogeneous group engaged in performing as good as possible in the virtual world of SECONDS. Collaboration issues have been discussed quite open even when the attendees came from different organisations.

The next step is the generalisation of the approach. This includes the definition of a step-by-step methodology for preparing and executing workshops with the objective to identify end-user requirements based on the application of serious gaming. This methodology will include templates to gather necessary information from end-users as well as guidelines for the workshop execution and means to analyse and further work on the output (i.e. the generated requirements).

Acknowledgements

This work has partly been funded by the European Commission in the context of project COIN under contract FP7-216256. We would like to thank the whole COIN consortium and the European Commission for their support.

References

Claussen, B.; Fürst, D.; Selle, K.; Sinning, H. (1996): Zukunftsaufgabe Moderation. Herausforderung in der Raum- und Umweltplanung. Frankfurt/Main (Dokumentationen zur wissenschaftlichen Weiterbildung, 28).

Hull, E.; Jackson, K.; Dick, J. (2005): Requirements Engineering. 2nd Edition. Springer, London.

Duin, H.; Baalsrud Hauge, J. (2008): refQuest – A Multiplayer On-Line Game to Support Idea Creation in Innovation Processes: An Ideation Game from the Laboranova Project. In: Proceedings of the 4th International Conference on Web Information Systems and Technologies (WEBIST 2008), 5.-7. Mai, Funchal, Madeira, Portugal, 2008, pp 447-454.

Hunecker, F. (2008): A Generic Process Simulation Model for Serious Games in Manufacturing. In: Tan, H. K.; Muyldermans, L.; Johal, P. (Eds.): Teaching and Learning through Gaming and

Simulation. Proceedings of SAGSET2008, 38th Annual Conference, Nottingham, UK, 17-18 July 2008. Nottingham University Business School. pp 77-84.

Hesmer, A.; Hribernik, K. A.; Baalsrud-Hauge, J.; Thoben, K.-D. (2007): Supporting the Systematization of Early-Stage-Innovation by Means of Collaborative Working Environments. In: Trends in Computer Aided Innovation. Proceedings of: 2nd IFIP Working Conference on Computer Aided Innovation, 8–9 October 2007, Michigan, USA. Springer, Boston, 2007, pp 135-144.

Schlosser, C.; Jones, S.; Maiden, N. (2008): Using a Creativity Workshop to Generate Requirements for an Event Database Application. In: Paech, B. et al (Eds): REFSQ 2008, Lecture Notes in Computer Science 5025. Springer, Berlin, Heidelberg, pp. 109-122.

Innovation through Virtual Communities of Practice: motivation and constraints in the knowledge-creation process

A. Correia[1], , A. Mesquita[2*], A. Paulos[3]

[1] IAPMEI – Instituto de Apoio ás Pequenas e Médias Empresas e à Inovação, I. P, and ISEGI – Universidade Nova de Lisboa, Lisboa, Portugal

[2] ISCAP / IPP, S. Mamede Infesta, and *Algoritmi* Centre, Group of Information Systems (Universidade do Minho), Portugal

[3] ISEG – Instituto Superior de Economia e Gestão, Lisboa, Portugal

* Corresponding author: sarmento@iscap.ipp.pt, +351 22 9050008

Abstract: Communities of Practice are places which provide a sound basis for organizational learning, enabling knowledge creation and acquisition, thereby improving organizational performance, leveraging innovation and consequently increasing competitiveness. Virtual Communities of Practice (VCoP) can perform a central role in promoting communication and collaboration between members who are dispersed in both time and space.

The ongoing case study, described here, aims to identify both the motivations and the constraints that members of an organization experience when taking part in the knowledge creating and sharing processes of the VCoP to which they belong. Based on a literature review, we have identified several factors that influence such processes; they are used to analyse the results of interviews carried out in this study of three multinationals.

Keywords: Virtual Communities of Practice; knowledge creation: knowledge transfer; innovation in organizations.

I- Introduction

With accelerated market volatility, faster response times and increased globalization, business environments are going through a major transformation and firms have intensified their search for strategies which can give them competitive advantage. This requires that companies continuously differentiate their products: that is, firms must constantly innovate. Innovation consists of new ideas that have been transformed or implemented as products, processes or services, generating value for the firm (Popadiuk and Choo 2006: 309).

With such a demand for new ideas, it is often the case that no one individual can satisfy this. Often, individuals when performing knowledge intensive tasks or faced with new problems, rely on informal relationships and engage in interactions to reduce uncertainty, generate ideas and create and use new knowledge. These informally established groups of self-organized individuals, working on similar problems, help each other to broaden their knowledge base and share perspectives about their work practices; this often results in the learning and innovation environment that has been labeled as a Community of Practice (CoP). In the context of this paper, we are concerned with Virtual Communities of Practice (VCoP), which are those in which their members use ICT as their primary mode of interaction (Dubé *et al.* 2006: 147).

This paper is organized as follows: the next section, drawing on a literature review, synthesises both the motivations and the constraints that members of an organization experience when taking part in the knowledge creating processes of the VCoP's to which they belong; the third section describes an ongoing case study, taking place in Portugal, in order to identify these experiences. It details the methodology used and presents the results of the interviews with members of the VCoP within three multinationals. Results are also discussed. Finally, some conclusions on this research are drawn.

II- Virtual Communities of Practice: motivations and constraints in the knowledge creation process

Knowledge creation in VCoP is conditioned by several factors that can motivate or constrain this process. These can be individual (*e.g.,* intrinsic factors) or collective (*e.g.* extrinsic factors related to the community), organizational (*e.g.,* cultural and structural) or technological (*e.g.,* user-friendly systems) as explained in the following paragraphs:

- Individual:
  - Intrinsic factors (Soft) – Members get involved in acts of knowledge creation motivated by factors related to their personality, the satisfaction they feel by sharing their knowledge with others (Deci 1975; Krogh and Grand 2002).
  - Extrinsic factors (Hard) – financial rewards, direct or indirect for sharing or creating knowledge (Hall 2001; Hall and Graham 2004). If members consider the cost/benefit relationship positive, they will get involved in these processes, otherwise they will stop sharing (Kelly and Thibaut 1978). These factors are considered as short term motivations (Sharratt and Usoro 2003: 191), and are important to attract new members to the community, but in the medium and long term they provoke more problems than benefits (Hall e Graham 2004).
- Collective – Factors related to the context in which the group operates. For instance, if the group to which the members belong (organization or CoP) does not allow the development of feelings of trust (Roberts 2006), they tend not to share their knowledge and are afraid of asking questions (Krogh and Grand 2002).
- Organizational culture – The involvement of workers in the process of knowledge development is conditioned by cultural factors (Davenport and Prusak 2003), a culture that motivates and rewards knowledge sharing, creates advantageous conditions for the development of knowledge creation. Values, language and common frameworks (Davenport and Prusak 2003; Sharratt and Usoro 2003) or 'opportunity structures' can provide a fertile environment inside the community (Krogh and Grand 2002). A shared vision and well-chosen organizational objectives also influence this process, because they promote a feeling of involvement with the organization and a willingness to contribute within the workforce (Kim and Lee 2005).
- Organizational structure – Organizational structures influence the sharing attitudes of collaborators (Kim and Lee 2005) which, in turn, influences knowledge creation. Chung (2001) believes that bureaucratic and centralized organizational structures tend to constrain knowledge creation, while more flexible and decentralized ones tend to motivate knowledge sharing, especially as regards tacit knowledge, because it allows a higher level of interaction between members.
- Technological factors – Among the constraint factors associated with technology, the values related with non-verbal language (*e.g*. cues, rituals) so essential to tacit knowledge sharing, is lost (Krogh and Grand 2002). This constraint is offset to some extent by the ease of access afforded by information technology, increasing the possibilities of communicating and collaborating to resolve problems, while also allowing access to more information (Sharratt and Usoro 2003).These aspects of technology can thus be considered as motivating or constraining knowledge creation in virtual environments. Technology should therefore allow members to socialize, be easy to use (user friendly) and offer an assessment of the "health" of the community (*e.g.,* number of registered members, number of active members, number of knowledge artifacts and their production dates) (Preece and Maloney-Krichmar 2003: 25).

III- The case study

Methodological approach

The research design uses a case study approach (Benbasat *et al.* 1987; Eisenhardt 1989; Saunders *et al.* 2003: 93; Yin 2003); to increase the scientific rigour a multiple case study was developed for three organizations each one with several "case units", *i.e* in each two or three VCoP are analysed (Benbasat *et al.* 1987; Yin 2003). In such circumstances, it is possible to obtain enough data to promote intra and inter organizational analysis and in this way increase the study's relevance.

This is an exploratory study; its aim is to explore the concepts, causes and facts, which determine people's attitudes. It takes a qualitative approach to the collection and analysis of data (Creswell 2003: 212-15; Flick 2005: 271). The process of gathering data occurred in two phases:

Phase A - comprised the non-structured interviews (Creswell 2003; Flick 2005; Ghiglione and Matalon 2005: 105; Miles and Huberman 1994; Saunders *et al.* 2003: 248) involving the leaders of VCoP, with the objective to refine the theoretical model developed from the literature review, with the application of a questionnaire. This also served to characterize the VCoP under study (Dubé *et al.* 2006);

Phase B - comprised the semi-structured interviews (Creswell 2003: 212; Flick 2005; Ghiglione and Matalon 2005: 105; Miles and Huberman 1994; Saunders *et al.* 2003 248; Zafeiriou *et al.* 2001: 86). Its framework was developed using the theoretical model of the previous phase and involved the members of VCoP (Barañano 2004: 93) Its objective was to verify the framework, as it related to the motivations and constraints felt by the members.

Data analysis and discussion of results

Data was gathered in three multinationals of the IT sector. These organizations were chosen as knowledge-based organizations (Engwall and Kipping 2002; Maister 1993).

In the organizations under study, we identified several types of VCoP:

i) **Strategic Communities** – The objective is the creation of competitive advantages and innovation. The members of these communities usually assume tasks at the highest level, or they are those, in the organization, considered to be experts in the domain. Normally, they also belong to operational communities in the field, where they perform their activities. They correspond to the epistemic communities presented by Amin and Roberts (2008) and Cohendet and Llerena (2003);
ii) **Operational communities** of professionals that assume tasks at an intermediary level (*e.g.,* communities of project managers or sales people). These kind of communities usually have the objective to develop knowledge (to improve the performance of collaborators) and the creation of competitive advantages and innovation (taking as a starting point, the knowledge created in the community);
iii) **Operational communities with a more technical interest** (*e.g.,* community of software development professionals) with the objective to improve the performance of collaborators;
iv) **Operational communities with interest in activity sectors, as distinct from professional areas**. They can be found in the commercial sector and their objective is to develop knowledge on how the activity sector, to which they belong, acts and works (*e.g.,* communities for the governmental sector or big enterprises);
v) **Ad-hoc communities** that emerge naturally from the requirements of the organizational collaborators; for instance, when a new technology or a new professional interest emerges spontaneously. Some of these communities evolve to become operational communities or even strategic communities, while others disappear when the knowledge domain of the VCoP is no longer important.

In Phase A, interviews were conducted via e-mail, since we were not able to arrange interviews face-to-face; according to the literature, this does not compromise the results of the study (Foster 1994: 1286; Jansen *et al.* 2007; Mariampolski 2001; Meho 2006: 1285; Sheehan and McMillan 1999). We interviewed 7 people in this phase.

Data from Phase B was gathered by both face-to-face interviews and through instant messaging. The first method was preferred because it allowed personal contact. The second

was necessary to accommodate the timetables of the interviewees; again, this does compromise the study (Fontes and O'Mahony 2008: 2, 4; Mann and Stewart 2000).

In the next paragraphs we present and discuss some of the major results. First, motivating factors are presented; these are then followed by the constraining ones.

Motivating factors

Results show some interesting conclusions. None of the interviewees referred to direct extrinsic factors, such as financial rewards, as an issue to encourage people to actively participate in the VCoP. Also, none of them referred to organizational structure as a key issue, although one of the interviewees mentioned aspects concerning organizational culture as a potential factor which might cause the reuse of existing artifacts, rather than seeking new ways of doing things:.

> "*Individuals are strongly encouraged to reuse all kinds of work artifacts, maybe even more than they are encouraged to contribute.*" (interview D)

There is also a generalized tendency to consider that success and even professional survival depends on membership of these communities. Individuals are also motivated by the fact that the VCoP allows access to a huge amount of information and knowledge, which might be denied in other circumstances. This information and/or knowledge might be the key for the success of the individual or organization. Some interviewees consider these communities as "*the basis of knowledge in our distributed world*" (interview D).

One of the interviewees established a direct connection between the VCoPs and innovation, stating that these communities constitute a fundamental resource:

> "*But the true value comes from adapting what's available and using it to really innovate. This is not the most common use of these resources, but I think it is the one that makes a difference. By doing this, individuals can make the most of what the community has to offer*" (interview D).

Constraining factors

The most important factors designated as a barrier to active participation in the community, in order to contribute, use and create knowledge, are lack of time for these activities and the difficulty to reconcile them with the daily professional stress situation. One of the interviewees also highlighted the fear of losing his / her job and the position he / she occupies in the hierarchy as a key issue preventing members from sharing what they know. However, this person also said that this feeling belongs more to the past rather than to the present. This means that something in the organization is changing; this might be generated in the VCoPs or even in the way people now see the importance of knowledge sharing to the survival of the organization, to keep the job and the development of an idea.

> "*the only thing that I can think of is protecting one's position by retaining knowledge in a particular aspect. In fact, I think I never experienced such a position from any of the people I work with, but I have seen it a couple of times in a distant past. Could be part of a normal change resistance process that has now ended.*" (interview D).

Some constraints have also been identified, in aspects concerning culture and organizational issues, that limit the sharing, reuse and creation of knowledge in the communities, One of them concerns lack of recognition, when sharing and making available information and knowledge. However, this problem has only been pointed out in one of the organizations studied. Another constraint relates to the lack of knowledge concerning the existence of communities of practice in the organization.

In terms of intangible factors, interviewees said that there is a natural human tendency to use existing knowledge artifacts since "using" new ones takes extra time and effort. This category only emerged in data gathered from the interviewees; it does not appear in the literature. These issues concern the learning and innovation process. Members see these processes as consuming additional time and resources; not all of them want to make this investment

.

"*There's a natural tendency for just using what's available, to transform it and innovate takes time and additional effort*." (interview D).

Another barrier relates to the characteristics of each member; readiness to learn will vary from person to person: "*It takes time to learn, and not everybody will be able to do it at the same level.*" (interview D)
Some cultural differences and literacy difficulties, due to the fact that all members do not have the same mother language, have also been pointed out. The communication among collaborators throughout the world is affected by cultural differences (*e.g.,* expressions that are used in a certain country and that can be misunderstood or not understood at all by persons of other countries) and mother tongue. This can give rise to a breakdown in communication.
Another issue concerns the existence of a large number of knowledge artifacts with little or no relevance to the work of members.

The technological aspects have been widely referred as constraints preventing an active involvement in the community. Within this category there are the problems related to the difficulty of access to the community; this manifests itself in slow response times; poor web design, the lack of tools to extract information efficiently, tools that are difficult to use and that are not adequate to the requirements of the knowledge sharing process. These factors are so important that one of the interviewees considers that technological limitations are the only constraint to knowledge sharing:

"*For me, at a personal level in terms of willing to share, there are no barriers, just lack of tools / systems allowing keeping and gathering knowledge in an easy way while ensuring that it is always updated (the personal contact with other members is not always possible, efficient and effective)*" (interview F).

IV- Conclusions and recommendations

The results of this research have already identified three critical issues, when organizations try to take advantage of the full potential of Virtual Communities of Practice as an information source and as a privileged place of knowledge creation and innovation:

1) in spite of the investment in and availability of the communities, organizations seem not to be ready yet to profit from one of their main assets – innovation – and through it, the creation and generation of collective advantages. Interviewees mention the lack of a sharing and collaborative culture in the process of knowledge creation. Motivation only concerns the reuse of knowledge artifacts, efficiency and productivity and not the creation of innovative ideas;

2) due to the lack of a clear relationship between cost and benefits, in active participation in the community, interviewees see the lack of time as a big constraining factor;

3) technological factors are also mentioned as significant barriers to the process of knowledge creation.

As for factors that motivate members to participate, the recognition of the community as a knowledge source, giving ready access to experts and encouraging professional development, is very important.

It is recommended that organizations promote the role of VCoP as sources of innovation, which create competitive advantage by developing a culture where knowledge sharing and reuse of information is recognized and valued.

References

Amin, A. and Roberts, J. (2008) 'Knowing in action: Beyond Communities of Practice', *Research Policy*, Vol. 37, pp. 353-369.

Barañano, A. M. (2004) *Métodos e Técnicas de Investigação em Gestão*, Lisboa: Edições Sílabo.

Benbasat, I., Goldsteins, D. K. and Mead, M. (1987). The Case Research Strategy in Studies of Information Systems. *MIS Quarterly,* Vol. 11, No. 3, pp. 369-385.

Creswell, J. W. (2003) *Research Design - Qualitative, Quantitative and Mixed Methods Approaches,* 2nd, London: Sage.

Davenport, T. H. and Prusak, L. (2003) *Conhecimento Empresarial: Como as organizações gerenciam o seu capital intelectual*, Rio de Janeiro: Editora Campus.

Deci, E. L. (1975) *Intrinsic motivation.* New York: Plenum Press. .

Dubé, L., Bourhis, A. and Jacob, R. (2006) 'Towards a Typology of Virtual Communities of Practice', *Interdisciplinary Journal of Information, knowledge, and management*, Vol. 1, pp. 69-93. URL: http://ijikm.org/Volume1/IJIKMv1p069-093Dube.pdf.

Eisenhardt, K. M. (1989) 'Building Theories from Case Study Research', *Academy of Management. The Academy of Management Review*, Vol. 14, No. 4, Oct, pp. 532-550. URL: http://pages.cpsc.ucalgary.ca/~sillito/cpsc-601.23/readings/eisenhardt-1989.pdf.

Engwall, L. and Kipping, M. (2002) Introduction: Management Consulting as a Knowledge Industry. *In* Engwall, L. and Kipping, M. (Eds.). *Management Consulting: Emergence and Dynamics of a Knowledge Industry* (pp. 1-16). New York: Oxford University Press.

Flick, U. (2005) *Métodos Qualitativos na Investigação Científica*. Lisboa: Monitor.

Fontes, T. O. and O'Mahony, M. (2008) 'In-depth interviewing by Instant Messaging', *Social Research Update*, Spring, Vol. 53, pp. 1-4.

Foster, G. (1994) 'Fishing with the net for research data', *British Journal of Educational Technology*, 25, 2, October/December, 91-97, quoted in Lehu, J.M., 2004. Back to life! Why brands grow old and sometimes die and what managers then do: an exploratory qualitative research put into the French context. *Journal of Marketing Communications*, Vol. 10, pp. 133-152.

Ghiglione, R. and Matalon, B. (2005) *O Inquérito: Teoria e Prática, 4ºed*, Oeiras: Celta Editora.

Hall, H. (2001) Social exchange for knowledge exchange. Paper presented at the Conference *Managing knowledge: conversations and critiques* University of Leicester, 10-11 April 2001. URL: http://www.soc.napier.ac.uk/publication/op/getpublication/publicationid/321908

Hall, H. and Graham, D. (2004) 'Creation and recreation: motivating collaboration to generate knowledge capital in online communities', *International Journal of Information Management,* Vol. 24, pp. 235-246.

Jansen, K. J., Corley, K. G. and Jansen, B. J. (2007) *E-Survey Methodology*. Penn State College of Information Sciences in Technology. URL: http://www.websm.org/uploadi/editor/1174987205esurvey_chapter_jansen.pdf.

Kelly, H. H. and Thibaut, J. W. (1978) *Interpersonal Relationships: a Theory of Interdependence*, New York: Wiley. .

Kim, S. and Lee, H. (2005) Employee Knowledge Sharing Capabilities in Public & Private Organizations: Does Organizational Context Matter? *Proceedings da 38th Hawaii International Conference on System Sciences.* Big Island, Hawaii, Los Alamitos, Calif.: IEEE Computer Society, pp. 1-10.

Krogh, G. v. and Grand, S. (2002) From Economic Theory toward a Knowledge-Based Theory of the Firm. In Choo, C. W. and Bontis, N. (Eds.). *The Strategic Management of Intellectual Capital and Organizational Knowledge* (pp. 163-184). New York: Oxford University Press.

Maister, D. H. (1993) *Managing the Professional Service Firm*, New York: The Free Press.

Mann, C. and Stewart, F. (2000) *Internet Communication and Qualitative Research: A handbook for researching*, London: Sage.

FQS - Forum Qualitative Sozialforschung / Forum: Qualitative Social Research (2001) *Qualitative Market Research: A Comprehensive Guide*. URL: http://www.qualitative-research.net/index.php/fqsMeho, L. I. (2006) 'E-Mail Interviewing in Qualitative Research: A Methodological Discussion', *Journal of the American Society for Information Science and Technology*, Vol. 57, No. 10, pp. 1284-1295.

Miles, M. B. and Huberman, A. M. (1994) *Qualitative Data Analysis: An Expanded Sourcebook, 2 ed.*, Beverly Hills: Sage Publications.

Popadiuk, S. and Choo, C. W. (2006) 'Innovation and knowledge creation: How are these concepts related?' *International Journal of Information Management*, Vol. 26, pp. 302-312.

Preece, J. and Maloney-Krichmar, D. (2003) *Draft - Online Communities: Focusing on sociability and usability,* Final version in*:* Preece, J. and Diane Maloney-Krichmar (2003) Online Communities*. In* J. Jacko and A. Sears, A. (Eds.) *Handbook of Human-Computer Interaction*, Mahwah, NJ: Lawrence Erlbaum Associates. pp. 596-620. URL: http://socialcomputingresearch.net/articles/preece_onlinecommunities.pdf

Roberts, J. (2006) 'Limits to Communities of Practice', *Journal of Management Studies*, Vol. 43, No. 3, May, pp. 623-639.

Saunders, M., Lewis, P. and Thornhill, A. (2003) *Research Methods for Business Students 3rd Edition*, Financial Times: Prentice Hall.

Sharratt, M. and Usoro, A. (2003). 'Understanding Knowledge-Sharing in Online Communities of Practice', *Electronic Journal on Knowledge Management* [on-line], Vol. 1, No, 2, pp. 187-196. URL: http://www.ejkm.com/volume-1/volume1-issue-2/issue2-art18-sharratt.pdf.

Sheehan, K. B. and McMillan, S. J. (1999) 'Response variation in e-mail surveys: An exploration', *Journal of Advertising Research*, Vol. 39, No. 4, pp. 45-54.

Yin, R. K. (2003) *Case Study Research - Design and Methods*, London: Sage.

Zafeiriou, G., Nunes, J. B. and Ford, N. (2001) 'using students perceptions of participation in collaborative learning activities in the design of online learning environments', *Education for Information*, Vol. 19, No. 2, pp. 83-106.

Activity based creative methodology for new product concepts - an educational case study

Denis A. Coelho[1,*]

[1] Engineering Sciences School, University of Beira Interior, Covilhã, Portugal

* Corresponding author: denis@ubi.pt, +351.275.329.943

Abstract: Design Science and Product Development methods emphasize the use of requirements specification as a starting point in new concept generation. Industrial Design students seem to work better with concept generation initiation starting from ideas in context rather than using verbal requirement lists as inputs for new concept generation. The paper describes a method developed for use in the classroom, which takes as the point of departure human activity to search for new product concepts. The method is based on searching for answers to the question "how can this human activity be enhanced, supported or enabled by an artefact?", thus containing the potential to trigger the generation of concepts beyond the existing solutions, and pushing the envelope of creativity beyond the mere upgrade of existing concepts. The method is also based on systematic design procedures to evaluate and improve the initial concepts and guide their development. New concepts involving a paradigm shift represent a challenge for their widespread adoption, but also a great opportunity. The paper also hypothesizes that the concept generation method presented may well be applied to support paradigm shift in activities with a larger scope and proposes adaptations in the method to support application at systems design level, particularly concerning Computer Supported Collaborative Work.

Keywords: Industrial Design; Activity Theory; Design Science

I- Introduction

Design studies portray a strong component of visual Arts, but, especially in what concerns Industrial Design, a technological component must be strongly emphasised in education to achieve a "well rounded" graduate. These two streams need to be balanced, in order to promote adequate education. This calls for the need to bring together "hard" engineering design approaches to design with "soft" creativity stimulation approaches, in line with Campbell et al. (2003) futuristic view on the 'hybrid' designer. Developments relating to awareness of people's experience prove that design and user research methods are evolving (Suri, 2003). A method based on activity theory, a theory founded by Leont'ev that was based on Vigotsky's cultural-historical psychology, is used in class to explore contexts of use and thus generate innovative product concepts, many times in radical rupture with existing solutions.

In what follows, a short overview of systematic design and product development as well as of activity theory is provided, which is then followed by a presentation of the education case study centred in the creative methodology for new concept generation based on human activity. A few examples of student results achieved with this methodology are shown. The examples provided are used as a basis to point out opportunities and challenges pertaining to each of the examples but also to what radically new product concepts embed in general. These may often involve a paradigm shift and represent a major challenge for their widespread adoption, even if they have big attractiveness in many dimensions. Finally, a hypothesis is expressed about the applicability of the concept generation method presented to support paradigm shift in activities with a larger scope. Applicability of the method to support new concept generation at systems design level is discussed with adaptations suggested. Two examples, taken from literature, of the use of activity theory based frameworks to guide systems design are also discussed, leading to emphasizing the differences between the proposed method, and the methods already applied.

II- Systematic design and product development

The short overview of systematic design and product development classic literature, presented ahead, aims at emphasizing the imbalance between the implicit importance of idea or concept

generation in new product development and its less supported description in comparison to other tasks prescribed in a more detailed manner.

Product development is part of any company's industrial innovation process (Roozenburg and Eekels, 1995). Industrial innovation includes all activities preceding the launch of a new product into the marketplace, such as basic and applied research, design and development, market research, production, distribution and sales. According to Roozenburg and Eekels, product development encompasses two phases: product planning and strict development. During product planning the company willing to place new products in the market identifies in explicit terms what it wants to achieve (in a requirements list specification). With this in mind, the idea finding commences, yielding the generation of one or more promising ideas for a new product. During the strict development phase, the plans for product, production and sales are developed.

Pahl and Beitz (1988, 1996) developed another well accepted method of product development, consisting of four phases: product planning and task clarification; conceptual design; embodiment design, and detail design. Under the label Design for X, a wide collection of specific design guidelines are also contemplated. Each design guideline addresses a particular issue that is caused by, or affects, the characteristics of a product. Pahl and Beitz (1996) consider several design for X, or design for properties, examples, such as: design for aesthetics, design against corrosion damage, design to cost, design for ergonomics, design for minimum risk, and, design to standards.

In line with Pahl and Beitz, Hubka and Eder (1992), systematically examine the basic goals, general principles, and methods of engineering science and specify product development phases and respective outcomes as follows:

- Elaborate and clarify the assigned task. Output: the design specification.

- Establish the function structure. Output: the function structure.

- Establish the organ structure. Output: the concept.

- Establish the component structure. Output: the layout.

- Establish component structure in more detailed level. Output: representation and description of technical system.

One of the challenges in trying to achieve a balance between technical and artistic inputs into product development education to industrial design students, is being able to introduce the technical systems design view presented in this section, and intertwine with another (rather more user / person centred) approach. Activity theory is being used as a basis to achieve this aim. For the traditional mechanical design methodology mentioned, Hubka and Eder (1992) and Pahl and Beitz (1996), the main objective of product design is to meet functional requirements. It hence dedicates only but marginal attention to the user. The theories of these authors mostly focus on the technical functions and structure of the product and omit the product's relation to the user. Some of the theories, as is the case for Pahl and Beitz (1996), provide limited guidance on how and where in the design process some of the user aspects should be dealt with (for example, identifying and understanding user / people needs).

III- Activity theory

This section aims at providing an introduction to activity theory, in order to set the basis for its application in the concept generation method central to this contribution. In a framework derived from activity theory, any task, or activity, can be broken down into actions, which are further subdivided into operations. In a design context, using these categories can provide the designer not only with an understanding of the steps necessary for a person to carry out tasks, but also with the motive and goals of the person's actions.

Hydén (1981) considers that the objectives and motives of any human activity, the social and material or physical perceptions, and the needs of the human determine the activity and its structure. The means for carrying out an activity include techniques and skills, procedures, artefacts, where language and tools such as products can be included. Karlsson (1996) developed a framework to study the relation between human and artefact. The focus is on the individual and his/her relation to the objective and the mediating artefact. Karlsson considers that use implies a goal (use for what?), an instrument (use what?), a person (use by whom?) and an environment and context (used where?).

IV- Activity theory based new concept generation

This method is based on the adaptation of an ergonomic design approach structured by activity theory, established by Coelho and Dahlman (2006). An educational case study centred in the creative methodology for new concept generation based on human activity is presented. The method was developed for use in the classroom, in the author's Product Design course within the second year of the undergraduate program in Industrial Design, and takes as a point of departure human activity, in order to search for new product concepts. The following is an example of the starting point for the generation of new concepts by industrial design students in the present method proposed for new concept generation.

Project X

Product:	*device Y (tele-ski)*
Task to be performed:	*support human activity climbing uphill in preparation for downhill*
Client: (imaginary)	*- electromechanical equipment supplier for winter sports resorts*
Client goals:	*- offer safety in access, transportation and descent;*
	- portray an avant-garde image to winter sports resorts.
Client base:	*Iberian Peninsula*
Existing equipment:	*tele-chair, transporting rod; lateral transporting rope; conveyor belt.*
Human activity (user goals):	*- gain altitude to restart descent*
	- socialize;
	- physically relax;
	- enjoy the landscape.
Environment and context:	*- dichotomy novice / expert;*
	- use of rucksacks;
	- protection against wind gusts;
	- profitability of equipment off season.

The description given above is an example intended to trigger students to apply this way of starting concept generation in their particular assigned projects. The method is then based on searching for answers to the question “how can this human activity be enhanced, supported or enabled by an artefact?”, based on considering the goals, instruments, person and context information, structured according to activity theory, rather than establishing a “*tout court*” requirements list specification. This method thus contains the potential to trigger the generation of concepts beyond existing solutions, and pushing the envelope of creativity beyond the mere upgrade from existing concepts.

The method is also based on systematic design procedures to evaluate and improve the initial concepts and guide their further development (Ulrich and Eppinger, 2004). It does not however explicitly establish links and relationships between design variables, performance specifications and user needs, and, or, utility function, as is suggested by Ulrich and Eppinger (2004), given the clash of this approach with a non requirement list focus, which is one of the main drivers in the method.

Two examples of student results achieved with this methodology are shown in Figure 1. Industrial Design Students seem to work best with concept generation initiation starting from ideas in context rather than using verbal requirement lists as inputs for new concept generation.

Figure 1. Student concepts enabled by the methodology presented: locomotion enhancing device with ability to charge electrical batteries for use in other devices (designed by André Monteiro) – 3D photo-realistic render; pillow with built in alarm clock-radio (designed by Sofia Dias) – photographic image actual functional prototype.

V- Challenges and opportunities

The examples provided can serve as a basis to point out opportunities and challenges pertaining to what radically new product concepts embed in general. These may involve a paradigm shift and represent a major challenge for their widespread adoption, even if they behold a big attractiveness in several dimensions (efficiency, usability, comfort, etc.). The method proposed contains the potential to trigger the generation of concepts beyond existing solutions, and therefore may be helpful in pushing the envelope of creativity beyond the mere upgrade of existing concepts.

Radical product development projects, which are undertaken to create new categories of products, present significant challenges to development teams (Seidel, 2007). In such settings existing formal processes may be limited or inappropriate, and objectives may be ambiguous and changing. McDermott and O'Connor (2003) claim that radical innovation within an organization is very different from incremental innovation and that it is critical to the long-term success of firms. However, these authors also support the idea that it is more difficult to get support for radical projects in large firms, where internal cultures and pressures often push efforts toward more low risk, immediate reward, incremental projects. McDermott and O'Connor (2003) state that there is considerably less knowledge available in literature about the effective management of the product development process in the radical than in an incremental context. Hence, the bigger challenges lie ahead of radical new concept generation, but the goal of the method presented herein is to foster such outcomes, regardless of their possible immediate application or envisaged hardships in implementation.

VI- Reflections on systems design

Systems design is the process of defining the architecture, components, modules, interfaces, and data of a (computer) system. Applicability of the method presented herein to support new concept generation at system design level is considered feasible, provided some adaptations to the activity theory based new concept generation method are done. The hypothesis being that the method of concept generation is applicable to support paradigm shift in activities with a larger scope. For instance, Computer Supported Collaborative Work application design at a

systems level could be a candidate for application of the method. Design at the level of systems is seen as the process of defining and developing a system to satisfy specified requirements. Object-oriented analysis and design methods are becoming widely used methods for computer system design. Analysis is done before the Design. Object-oriented analysis looks at the problem domain, with the aim of producing a conceptual model of the information that exists in the area being analyzed. Analysis models do not consider any implementation constraints that might exist, such as how the system is to be built. Implementation constraints are dealt with during object-oriented design. Object-oriented design transforms the conceptual model produced in object-oriented analysis to take account of the constraints imposed by the chosen architecture and any non-functional – technological or environmental – constraints. The concepts in the analysis model are mapped onto implementation classes and interfaces. The result is a model of the solution domain, a detailed description of how the system is to be built. In Computer Supported Collaborative Work, people (professionals, usually front-end professionals, e.g. nurses and medical practitioners in health care) base clinical record keeping and treatment orders on information systems that percolate through the whole clinical work environment (Patterson et al., 2000).

What is seen in such environments where Computer Supported Collaborative Work takes place is that artefacts (computer systems) are far from passive. These often have their own “agenda” which is often dictated either by technical limitations originating in software or hardware, or in other biases introduced at the design stage, and that combine to hinder efficient functioning of the system of people, technology and work. The hypothesis brought forward is that using the activity theory framework to inform object-oriented analysis and design methods for systems design could improve the quality of the collaborative work, both in between professionals and also between the professionals and the systems. To this aim, it is suggested that a chain of user dependencies, and, or hierarchy, is established, and individuals (both humans and artificial, or system, actors) are identified and analysed according to the activity theory framework presented and considered in the method, as an addition to the general object-oriented analysis and design methods in use.

Hence it is not with surprise that evidence of application of the aforementioned approach is noticed. Bardram (2005) presented a design philosophy coined as activity-based computing (ABC), which addresses mobility and cooperation in human work activities. It is based on the ABC framework, which the author describes as a ubiquitous computing infrastructure supporting ABC. The aims of ABC appear to be supporting: human activity by managing its collection of work tasks on a computer, mobility by distributing activities across heterogeneous computing environments, asynchronous collaboration by allowing several people to participate in an activity, and synchronous, real-time collaboration by enabling “desktop conferencing” by sharing the activity across several clients.

Another example of the use of an activity theory based framework in systems design is given by Ricci et al. (2005). The conceptual framework presented is influenced by research on activity theory applied to multi agent (computer) systems, where both subjective and objective coordination play an essential role. The authors demonstrate how each of these modes of coordination provides effective means for cooperative problems at different abstraction and operational levels: subjective coordination for the co-construction level, and objective coordination for the coordination level. Their work shows the benefits of supporting dynamic transitions between such levels, alternating co-operation stages, in which agents reason about coordination and cooperatively forge coordination artefacts (laws, constraints, norms), and co-ordination stages, where the artefacts, embodied in proper coordination media, are exploited, so as to enact automated, consistent and prescriptive coordination.

The examples discussed do not, however, totally put into practice the suggested method, since system goals are not explicitly considered in the hierarchical task analysis, and activity theory is applied to human actors in the first case discussed (Bardram, 2005), but not to artificial actors or system agents. The second case discussed (Ricci et al., 2005) considers multi agent collaboration within an environment for social interaction between computer agents, but does

not include the goals of human actors in the analysis, since these are previously extracted and translated to a requirements list.

VII- Conclusion

In this paper, a method for initiation of new concept generation was presented that is based on considering human activity goals and instruments, as well as person and context information, structured according to activity theory, rather than establishing a "*tout court*" requirements list specification. Adaptations suggested to apply the concept generation method to a larger scope of analysis, such as in a systems design level, include adopting a hierarchical view, and establishing several individual frames of analysis, considering activity of both human and artificial actors.

Acknowledgement

The industrial design concepts presented in this paper were developed by André Monteiro and Sofia Dias, at the time of first submission of this paper were undergraduate Industrial Design Students at UBI, as classwork in the author's Product Design course, given at the second year of the programme.

References

Bardram, E. (2005). Activity-based computing: support for mobility and collaboration in ubiquitous computing. Personal and Ubiquitous Computing 9(5).

Campbell, R.I., Hague, R.J., Sener, B., Wormald, P. W. (2003). The potential for the Bespoke industrial Designer. The Design Journal, 3 (6).

Coelho, D.A., Dahlman, S.D. (2006). Ergonomic Design Structured through Activity Theory. In Fischer, Xavier; Coutellier, Daniel (Eds.), "Research in Interactive Design" – Vol. 2, Paris: Springer Verlag.

Hubka, V., Eder, W.E. (1992). Enfürung in die Konstruktionswissenschaft. Berlin: Springer Verlag.

Hydén, L.-C. (1981). Psykologi och materialism: Introduktion till den materialistika psykologin, Stockholm: Prisma.

Karlsson, I. C. M. (1996). User Requirements Elicitation – A framework for the study between user and artefact. Doctoral Dissertation. Dept of Consumer Technology, Chalmers University of Technology, Gothenburg.

McDermott, C. M., O'Connor, G. C. (2003). Managing radical innovation: an overview of emergent strategy issues. Journal of Product Innovation Management 19 (6).

Pahl, G., Beitz, W. (1988). Engineering Design - a systematic approach, London: the Design Council / Springer Verlag.

Pahl, G., Beitz, W. (1996). Engineering Design - a systematic approach, 2nd edition, London: Springer.

Patterson, E.S., Coelho, D.A., Woods, D.D., Cook, R.I., & Render, M.L. (2000). The Natural History of Technology Change: How Introducing Bar Coding Changes Medication Administration. Paper presented at the Fifth Conference on Naturalistic Decision Making. Tammsvik, Sweden, 26-28 May.

Ricci, A., Omicini, A., Denti, E. (2005). Activity Theory as a Framework for MAS Coordination, in Paolo Petta, Robert Tolksdorf, Franco Zambonelli: Engineering Societies in the Agents World III, Springer-Verlag, pp. 295-394.

Roozenburg, N. F. M., Eekels, J. (1995), Product Design: Fundamentals and Methods, Chichester: John Wiley & Sons.

Seidel, V. P. (2007). Concept Shifting and the Radical Product Development Process. Journal of Product Innovation Management 24 (6).

Suri, J. F. (2003). The Experience Evolution: Developments in Design Practice. The Design Journal 2 (6).

Ulrich, K.,T., Eppinger, S.,T. (2004). Product Design and Development, international edition, McGraw-Hill.

A bottom up approach to evaluate risk in network environment

G. Lo Nigro[1,*], L. Abbate[1]

[1] Dipartmento di Tecnologia Meccanica, Produzione e Ingegneria Gestionale, University of Palermo, Italy

* Corresponding author: glonigro@dtpm.unipa.it, +3909123861826

Abstract: Firms dependence on environment has been contended in various ways; one of the most suited is the collaboration among other firms in order to realize extra rents. Firm dependence on environment is particularly crucial in sector characterised by complex technology or complex product (product requiring an articulated supply chain) that make the market instable. In this scenario the alliance, whatever is the inter-organizational solution chosen, causes new forms of dependence that are the origins of network risk. In order to evaluate correctly the extra rents a long range perspective has to be assumed and a financial analysis has to be followed. To evaluate expected cash flows it needs to known the cost of capital and then the risk of the considered investment. This research wants to contribute in this interesting research area for theorists and practitioners being its objective to propose a complete analysis of the network risk aiming at collecting in a harmonious view several contributions available in literature in order to quantify this kind of risk. This is the preparatory step to evaluate the cost of capital to be used to evaluate a network investment.

Keywords: Risk, firms network, cost of capital

I- Introduction

The new trends in inter-organization relationships push towards network solutions: companies are interested in relationships with partners and customers to overcome resource dependence, enter too risky market or simply differentiate their business portfolio. From Powell's seminal work [Powell, 1990], networked organisations have emerged as a new enterprise pattern able to better match the new competition arena requirements. From then on many papers have addressed hybrids from an economic point of view [Menard, 2004], from an organisational point of view [Grandori and Soda, 1995], and from a performance point of view [Mazzarol, 1998].

Network solution in organization field aims at realizing coordination among resources belonging to distinguished companies with the objective of pursuing economic benefits. The range of organization solutions embraced in this definition of network is wide: from supply chain relationships to strategic joint ventures.

As stated in Hallikas et al. (2004), through networking companies aims at reducing financial and technological risks improving their competitive advantage through deeper specialization. On the other hand specialization creates dependency on resources belonging to other companies, dependency increases outcome uncertainty, as a conclusion networking creates additional risks, the so called cooperation risks [Link and Marxt, 2004].

These considerations are too often act as inhibitor elements in the networking decision while it is necessary to accompany them with network opportunities in order to foster networking because of its importance as key element to compete in the today market.

Risk in networking asks for a dedicated study because of its peculiarities. Network risk has recently been object of several research studies: many researchers have classified risks originating in network environment and this is a preparatory step to risk management. In literature it is possible to find research on network risk but the problem is not investigated with a quantitative approach: our aim is to quantify the network risk. This objective has a high importance in the investment evaluation: if we want to evaluate the Net Present Value (NPV) of an investment it is necessary to know the correct cost of capital to be used. The Capital Asset Pricing Model (CAPM) is an equilibrium theory based on the theory of portfolio selection, able to

estimate the cost of capital basing on the β factor that synthesizes the risk of the investment respect to the market risk. Then if we estimate the risk of the network we could estimate the cost of capital to be used to evaluate the NPV for the network investment.

The paper is organized as follows: section two is dedicated to a literature review, section three proposes a network risk decomposition that allows to identify network parameters responsible for it, section four links the results of section three with the CAPM, section five proposes a method to assess network, in section six some conclusions are drawn and further developments are suggested.

II- Literature background

In the academic literature risk is defined as "the variance of probability distribution of outcomes" (March and Shapira, 1987). The achievement of a goal in a network environment depends on partners' relationship behaviour as well as on objective business environment. This leads to a multi-dimensional construct for risk because of the number of factors influencing outcomes especially in a network context. Das and Teng (2001) in their work split network risk in performance and relational risk, indicating the second as depending on relationship abilities of network partners. In their classification relational risk is concerned with the probability and consequences that a partner firm does not commit itself to the alliance in the agreed manner. Performance risk refers to those factors that may jeopardize the achievement of strategic objectives, given that the partners cooperate fully. They consider independent the two type of risk and propose to fit the best network governance depending on the amount of relational and performance risk forecasted.

Additional sources of risk in network context are indicated in (Link, 2001) and located especially at cultural level. The literature analysis seems to conclude that when networking is chosen to run a business the consequent risk is higher than the risk related to the same business runs by a single company, even if resource dependence theory suggests strategic alliance to share risk and networking is a tool to enter too risky market.

As already mentioned, Das and Teng (2001) distinguish performance risk and relational risk as components of network risk. Single firm effort and interfirm cooperation are alternative ways to carry out a project. A shared performance risk via an alliance will usually be lower than the performance risk of a project carried out by one firm. By pooling the resources of several specialised firms the likelihood of success is enhanced. Inasmuch, as the partners have contended with performance risk of a project, strategic alliances constitute an effective way to control that performance risk. Then it is useful to split also performance risk (as defined in Das and Teng, 2001) in two components performance risk as the risk incurred in by a single firm carrying out a project and a network performance risk referred to the network risk when the partners cooperate fully [Lo Nigro et al., 2007]. When the network solution is embraced relational risk occurs. As explained in Lo Nigro et al. (2007), risk is modified shifting from a single firm conducting the business to a network performing the same business; it is possible to model risk escalation as sum up of contributions from network performance risk and network relational risk.

Relational risk is related to lack of trust, inaccurate information sharing and asymmetry in reciprocal position that causes dependency (a partner acts as captive in the relationship) [Ojala and Hallikas, 2006].

Smallman (1996) proposes a categorization of direct and indirect risks that is helpful in the considered environment because it is worthwhile to be aware that risk may be partly influenced by an organization and individuals within it and partly by events beyond their influence. In this context risk can be categorised in direct and indirect referring to the network influence in their occurrence. That is a certain amount of the network risk is inherent the business while the complementary part is related to networking choice.

Combining Das and Teng classification with Smallman's categorisation using network as risk object, Lo Nigro et al. [2007] propose a network risk decomposition that individuates in performance risk a direct and indirect subcomponent while relational risk has just a direct nature, that is it is independent from the environment.

In order to clarify the proposed risk decomposition, it can be observed that network risk can be considered the combination of relational and performance risk: performance risk can be explained taking into account both objective business conditions (indirect performance risk) and network behaviour (direct performance risk). Performance indirect risk is the part of network risk not dependent on network characteristics, a systematic risk, while direct risk is directly related to network solution then it is an unsystematic or specific risk. It is worthwhile to observe that direct risk contribution could reduce performance risk. Our research starts from this decomposition to analyzing more deeply each component in order to evaluate network risk.

III- Network Risk: a multilayer model

As stated above network solutions refer to a wide range of inter-organizational relations so for the aim of the present research also literature about supply chain management and outsourcing is helpful. Aron et al (2005) decompose outsourcing risk in operational, strategic, atrophy and location risk. Matching this classification with the one proposed in Lo Nigro and Abbate (2007) we are able to analyse in deeper detail the problem: actually, operational risk is not caused by deliberate actions of the partners or by their unethical behaviour, while strategic one is always related to behavioural aspect and then intentional action to exploit other partners. Then strategic risk is a relational risk while operational risk is a performance one belonging both to the direct portion of the risk. Atrophy risk refers to the situation in which a firm externalises a function and misses the competences to do it, but in this case it refers to a lack of opportunity and it doesn't impact on network result variability. Location risk is an intrinsic risk because it depends on the scenario uncertainty of each single partner (due for example to location events) then it represents an indirect risk because it doesn't depend on network dynamics. These considerations allow us to separate the indirect risk in two parties: intrinsic and extrinsic network risk being extrinsic risk dependent on the market scenario.

In their research Choi and Krause (2006) propose some interesting insights about the impact of supply base complexity (SBC) on the focal company; they conclude that SBC is related positively with transaction costs and supply risk and negatively with supplier responsiveness and supplier innovation. Extending their conclusions on network context it can be defined a Network Complexity (NC) based on the number of partners, their interrelationships and their differentiation in terms of activities. The argumentations to carry on their conclusions can be borrowed for the network. NC is a network parameter that impacts on network risk, responsiveness and innovation capability (we will neglect transaction cost considerations that are more related to governance choice than to risk evaluation). On the other hand responsiveness is a crucial element for risk evaluation because it represents the mutual adaptation capability and then the network ability to react to external changes; innovation potential is also important to react in a fast changing market and to reduce results variability, then network complexity is determinant for network risk evaluation and in particular for its operational component.

Handfield and Bechtel (2002) study how trust and supply chain structure impact on supply chain responsiveness: they demonstrate that buyer dependence, trust and site specific assets (an idiosyncrasy component) impact on supply chain responsiveness.

Combining and extending these results to network context, we can conclude that network complexity, partner resource dependency and idiosyncrasy are network parameters influencing network operational risk.

Network strategic risk is linked with soft parameters as partner reputation, reputation importance and idiosyncrasy because of the hold up problem. These parameters act on hold up occurrence,

trust and trust responsiveness defined as “the tendency to fulfil trust because you believe that it has been placed on you” (Bacharach et al. 2001).

Then we can conclude that network parameters (NC, reputation importance, partner resource dependency, idiosyncrasy, partner reputation) affect network risk drivers: responsiveness, innovation potentiality, hold up occurrence, trust and trust responsiveness. The result of these argumentations is reported in table 1.

Risk Typology	**Risk Subcomponents**	**Drivers**	**Network Parameters**
Direct Indirect	Operational Strategic Intrinsic Extrinsic	Trust and trust responsiveness Responsiveness Innovation potentiality Hold up occurrence	Network Complexity (NC) Reputation importance (cost and difficulty to rebuild a reliable image, probability to discover and divulgate opportunistic behaviour) Partner Resource Dependency Idiosyncrasy (physical/financial investment, human resources and knowledge) Partner reputation (common knowledge and past experiences)

Table 1 A multi-layer model for network risk

IV- Cost of Capital measurement using CAPM

In order to measure in a quantitative manner network risk the model proposed in the previous section and the approach proposed in Lo Nigro and Abbate (2008) will be used. In Lo Nigro and Abbate the aim was to compute the β factor of the Capital Asset Pricing Model (CAPM), an equilibrium theory based on the theory of portfolio selection, able to estimate the cost of capital basing on the β factor that synthesizes the risk of the investment respect to the market risk. In the present paper to evaluate the β factor network parameters will be considered.

Let us indicate with β_I the CAPM β factor for the industry to which the considered network *N* belongs to; this factor takes into consideration the indirect extrinsic network risk because it considers the sources of risk that do not depend on network arrangement.
Let us indicate with β_{DN} the CAPM β factor for the direct component of network *N* risk; as in Lo Nigro and Abbate we can estimate β_{DN} through three betas parameters: β_I, the beta for the industry to which the network belongs to, β^S, the beta that takes into account the strategic component of the network risk and β^O that takes into account the operational component of the network risk (equation 1).

$$\beta_{DN} = f\left(\beta_I, \beta^S, \beta^O\right) \quad (1)$$

Network parameters reported in table 1 are responsible for β^S and β^O: in particular NC impacts negatively on responsiveness and then positively on β^O (that is an higher NC means higher risk); reputation importance impacts positively on trust and then negatively on β^S; partner resource dependence impacts negatively on responsiveness and then positively on β^O; idiosyncrasy impacts negatively on responsiveness and then negatively on β^O and impacts positively on trust and trust responsiveness and then negatively on β^S; partner reputation impacts positively on trust and trust responsiveness and then negatively on β^S. It is worthwhile to specify that a negative impact on β^S or β^O means that the values decrease, while a positive impact causes increased values. Then β^S and β^O can be decomposed in β_i^S and β_j^O one for each network parameters and arranged properly to evaluate β^S and β^O.

In order to evaluate the betas parameters it is helpful to know the total risk of each component (beta takes into account just the non diversifiable part of the risk). In the next section we propose a method to evaluate the total strategic risk and the total operational risk.

V- Network risk evaluation

We propose to estimate network risk using the decomposition proposed in table 1 and a procedure articulated in three steps.

The outcome of the network can change and then a risk arises for different reasons: first of all the fortuitous circumstances can change and this is related to the indirect and extrinsic part of the risk, secondarily each partner bears a certain amount of risk because its ability to react to external changes and this is related to the indirect and intrinsic part of network risk; when partners join to run a business the extrinsic indirect part and the direct part of network risk arise. The direct part can be decomposed in operational and strategic risk: when the operational risk subcomponent is addressed implicitly we assume that network partners cooperate fully.

First step

First step aims at evaluating the operational component of network risk. As stated in Choi and Krause we can assume a negative quadratic relationship between SBC and supplier innovation, a negative relationship between SBC and supply responsiveness, and a positive quadratic relationship between SBC and supply risk; on the other hand supplier responsiveness and supplier innovation have a negative relationship with supplier risk because the ability to innovate and react to scenario mutations helps to reduce variability in the expected outcomes and then risk. We prefer to consider network responsiveness and network innovation capability in order to stress that these are network parameters stemming out from the cooperation. Network responsiveness and network innovation capability (NRI) can be considered a unique network parameter responsible for the capacity of the network to react to external changes: actually a firm (or a network in our case) can react to changes thanks both to its capacity to exploit the intrinsic flexibility both to the ability to innovate reorganizing internal productive factors. It is also plausible, mimicking the financial portfolio theory, that even if NRI reduces network operational risk, there is a systematic part of it that cannot be eliminated (minimum operational risk, MinOR); moreover when NRI is null the operational risk is the risk deriving from the partner collaboration without afford to react to external changes (maximum operational risk, MaxOR). The convexity of the function depends on the importance that NRI has in the considered market; if the market is unstable then NRI is an important parameter and the risk will decrease speedily when NRI increases (Figure 1). NRI is difficult to measure and also its importance is difficult to evaluate, then a fuzzy approach to evaluate through linguistic variable NRI is suggested.

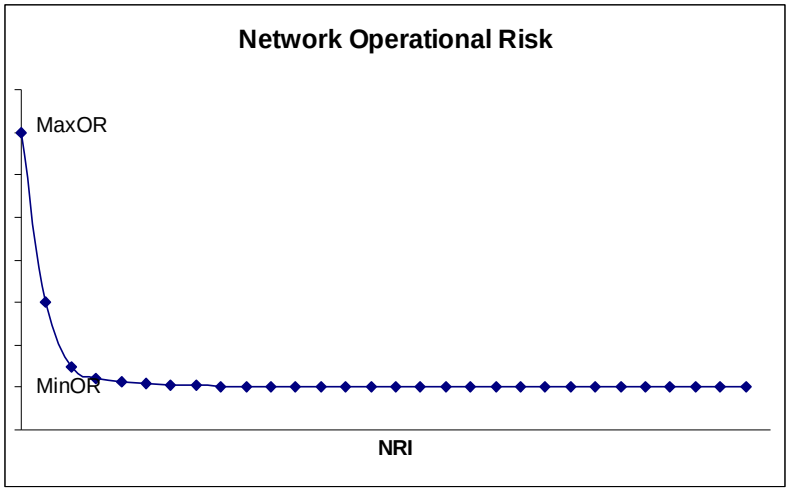


Figure 1 Network Operational Risk

Second step

Second step aims at evaluating the MaxOR. The MAxOR represents the operational network risk, when NRI is absent. This value is then dependent on the risk of each single partner belonging to the network; in particular let us indicate with σ_i^2 i=1,2,…,*M* the variance of the rate of return r_i for the partner *i*, i.e. its risk, with *M* the number of the partners and with ρ_{ij} j≠i and i,j=1,2,…,*M* the correlation coefficient between the rate of return of partner *i* and the rate of return of partner *j*.

If we consider the variable $N' = \sum_{i=1}^{M} r_i$ the variance $\sigma_{N'}^2$ will be:

$$\sigma_{N'}^2 = \sum_{i=1}^{M} \sigma_i^2 + \sum_{i=1}^{M} \sum_{j \neq i,\, j=1}^{M} \rho_{ij} \sigma_i \sigma_j \qquad (2)$$

and it represents the variance of the network when partner cooperate fully and no NRI is considered (MaxOR).

Third step

Third step aims at evaluating strategic risk and then at summing up the subcomponents individuated.

Drivers for strategic risk are: hold up occurrence and trust and trust responsiveness; the network parameters influencing these drivers are: reputation importance, idiosyncrasy and partner reputation.

Assuming the independence between the operational and the strategic risk the last one is an additive component respect to the first one. The minimum value that it can assume is zero that means that partners cooperate fully, the maximum value (MaxSR) is the one deriving from the worst partners behaviour, i.e. when hold up occurrence is high and trust and trust responsiveness is low. Let us indicate with THU the network driver obtained combining hold up occurrence and trust and trust responsiveness, and with NSR network strategic risk. Figure 2 shows as NSR varies depending on THU, in the figure a linear relationship has been assumed

but actually it depends on the importance of THU. THU has the characteristic of a linguistic variable then it is suggested a fuzzy approach to evaluate it.

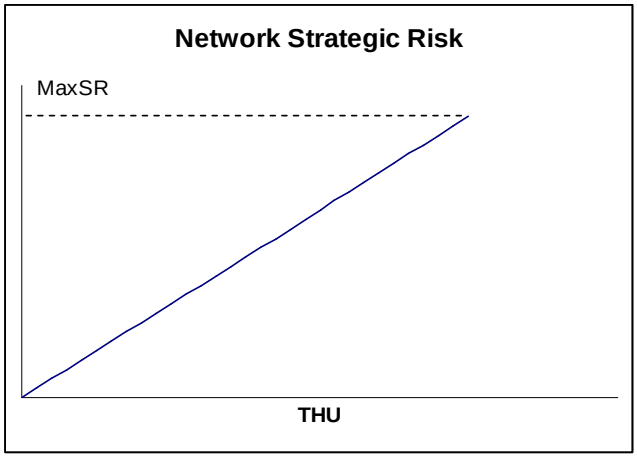


Figure 2 Network Strategic Risk

Step 2 allows to evaluate σ_N^2, that represents the MAxOR of figure 1, step 1 allows to evaluate NPR that, assuming the independence between the operational and the strategic risk, can be summed up to NSR computed in step 3 to obtain network risk.

VI- Conclusions

The research has pointed out a multilayer model for estimating risk in network environment. This argument is extensively examined in literature and various perspectives have been assumed to analyse the risk in this complex context but no effort has been done to quantify it in order to evaluate the convenience of a network solution. Risk evaluation is a complex task because it involves different management and research areas: supply chain management, organization economics, psychology and corporate finance. The proposed network risk decomposition incorporates contributes from these different areas and it has been used to build a three steps method to evaluate network risk.

Further developments will tackle with the problem of estimate the network drivers, NRI and THU using a fuzzy approach and to evaluate the importance of them respectively on Operational and Strategic Risk in order to set the relationship between the driver (NRI or THU) and the corresponding network risk direct component.

References

Bacharach., M., Guerra, G., and Zizzo, D. J., (2001), Is trust self-fulfilling? An experimental study, Discussion paper no. 76, October, Department of Economics, University of Oxford.

Choi, T. Y., Krause, D. R., 2006, The supply base and its complexity : implications for transaction costs, risks, responsiveness and innovation, Journal of Operations Management, 24 (2006), 637-652

Das, T. K. and Teng, B., 2001. A risk perception model of alliance structuring, Journal of International Management, 7, 1-29.

Grandori A., Soda G., 1995. Inter-firm networks: antecedents, mechanisms and forms. Organisation Studies 16 (2), 183-214.

Hallikas, J., Karvonen, I., Pulkkinen, U., Virolainen, V.-M.,Tuominen, M., 2004. Risk management processes in supplier networks. International Journal of Production Economics 90 (1), 47–58.

Handfield, R. B., Bechtel, C., The role of trust and relationship structure in improving supply chain responsiveness, Industrial marketing management 31 (2002), 367-382

Link, P. and Marxt, C., 2004. Integration of risk and chance management in the co-operation process, International Journal of Production Economics 90, 71–78.

Link, P., 2001, risikomanagement von Innovationskooperationen, Doctoral Tesis Nr. 14240, ETH Zurich, Zurich.

Lo Nigro, G., Abbate, L. , Risk and Profit Sharing mechanisms for network governance, Fiftheenth international working seminar on production economics, volume 4, pagg 141-152, march 3-7, 2008, Innsbruck, Austria

Lo Nigro, G., Abbate, L., Bruccoleri, M., Perrone, G., 2007. How risk consideration can affect inter-organization relationship decisions, Proceedings of 19th International Conference on Production Research, 29/7-2/8 2007, Valparaiso (Chile)

March, J.G., Shapira, Z., 1987. Management perspective on risk and risk taking, Management Science 33 (11), 1404-1418.

Mazzarol T., 1998. Partnerships: a key to growth in small business. 43rd ICSB Conference, Singapore.

Menard, C., 2004. The economics of hybrid organizations, Journal of Institutional and Theoretical Economics, 160 , 345-376.

Ojala, M and Hallikas, J., 2006. Investment decision-making in supplier networks: Management of risk, International Journal of Production Economics 104 , 201–213.

Powell W.W., 1990. Neither market nor hierarchy: network forms of organization. *Research in* Organizational Behaviour, 12, 295-336.

Ravi Aron, Eric K. Clemons, and Sashi Reddi, (2005) Just Right Outsourcing: Understanding and Managing Risk, Journal of Management Information Systems / Fall 2005, Vol. 22, No. 2, pp. 37–55.

Smallman, C., 1996. Risk and organizational behaviour: a research model, Disaster Prevention and Management, 5 (2), 12-26.

Measuring Innovation: a conflict between academic and world innovation awards viewpoints

C.A. Costa[1,*], F.J. Garcia[1]

[1] Design and Manufacturing Research Group, University of Caxias do Sul, Caxias do Sul, Brazil

* Corresponding author: cacosta@ucs.br, +55 54 3218 2100

Abstract: Innovation is said to be one of the main alternatives for gaining and maintaining organizations´ competitiveness, profits and momentaneous monopolies. For this reason, corporations choose their strategies centered on innovation or related to it. However, what are exactly the criteria that define a company as innovative? This paper discusses two different viewpoints of defining an innovative company, as well as some conflicts between them. A literature survey is presented from the academic viewpoint for definitions and characterizations of innovation process within a company, where twelve innovations dimensions have been identified. Based on these dimensions, a survey about 35 innovation awards, from different professional categories, entities and economic segments has been made, analyzing their decisions criteria against the academic viewpoint. The results have shown that the academic innovation definitions/characteristics are not always considered in the award evaluations. When assessing the dimensions of innovation, it was identified that a small portion of the twelve mapped dimensions were taken into consideration.

Keywords: innovation, dimensions, awards

I- Introduction

Innovation is one of the main alternatives for gaining and maintaining organizations´ competitiveness, and it has been adopted as a key strategy for corporations to keep themselves competitive. This theme has gathered academia and industrial professional to discuss its importance as part of companies' strategic position in the market (Porter, 1995; Rogers, 1995; Rothwell, 1995). Many companies entitle themselves as innovative. However, what exactly makes a company innovative or how companies´ can be innovative, based on what criteria?

Guidelines as Oslo Manual can be used as a mechanism to evaluate how group of organizations has behaved in relation to the innovation. Also, different awards have been used, around the world, to distinguish innovative companies in specific areas. However, one issue that this research has raised is: in which level the literature about innovation supports the base used by the innovation awards?

In a first part of this paper, a literature survey is made showing the conceptual ways, or dimensions, that academia have been defining innovation. Based on this different innovation awards are analyzed identifying what dimensions are considered by them. Finally, some discussions and conclusions are made.

II- Comparing Innovation Dimensions

Creativity, Invention and Innovation

Innovation is said to be one of the main alternatives for gaining and maintaining organizations´ competitiveness, profits and momentaneous monopolies. Innovation is usually associated with changing the way things have been doing, creating something new and/or transforming the environment around.

Creativity and invention are essential concepts to discuss and understand innovation (HAMEL, 2002). Usually companies are more structure for problem solving than thinking creatively (SENGE AND DRUCKER, 2002). However, creativity only makes sense for a company if it is applied to getting results, mainly in terms of its customer perception (FALLON AND SENN, 2006). One of the creativity results is the possibility of invention.

The technological improvement process can be separated in three phases: invention, innovation and divulgation (diffusion). The first one is a change made based on an initial idea. The second one is when this change has commercial potential. Finally, the third one is responsible for bringing the innovation to the market (ROGERS, 1995). Thus, what actually turns a changing into an innovation is the aspect or action of adding value to this changing (CRUCIO, 2003; SAWHNEY ET AL., 2006).

Dacorso and Yu (2002) state that maybe there is not a common accepted definition for innovation. Shumpeter was one of the authors who has addressed for the first time the nature of innovation, its repercussions and agents (ESCORSA e SOLÉ, 1988 apud OLEA, 2001). The author states that the innovation capacity was related to the market monopoly, i.e. an unique and valuable position in the market (PORTER, 1996, KOTLER, 2003, ROGERS,1995). The Oslo Manual states that innovation is the implementation of a new or significantly improved product, or process, or a new marketing, organizational method (OCDE, 2005). Thus, the innovative company has to understand and capture the behavior and needs of its costumers Dosi, 1988).

On the other hand, as most of the new concepts, innovation has to be better understand and different ways of classified it or, categorized it have been defined by the literature. This is the first aspect looked in this paper, which are called dimensions of innovation (Sawhney et al, 2006).

Dimensions of Innovations

In order to build a first referential of this work, this research has analyzed four innovation models: Schumpeter (1984) – originally published in 1910, Berreyre (1975), Oslo Manual (2005), and Innovation Radar (Sawhney, Wolcott e Arroniz, 2006).

In the traditional models, innovation is realized through three levels, i.e. product, process and management methods. One of the first classifications for innovation was identified by Schumpeter (1985). He addresses that innovation can be characterized in five different situations: new product creation, new production method creation, new market creation, new source, e.g. raw material, utilization, and new market structure utilization.

Berreyre (1975) presents four main innovation categories. This was identified in small and medium enterprises (Berreyre, 1975 *apud* Gasse e Carrier, 1992). The categories, or domain, are:

- Technological: innovations associated to new products, processes, raw material, etc.;
- Commercial: innovations associated to new distributions channels, new markets, new ways to expose the product, etc..;
- Organizational: innovations associated to changes in the company´s organization, management and procedures.
- Institutional: innovations associated to the Organizational domain, but focused on the external aspects of the company.

The Oslo Manual brings four dimensions to evaluate innovation, named: product, process, organization and marketing (OECD, 2005).

Finally, the Innovation Radar (SAWHNEY *ET AL.*, 2006) brings twelve dimensions, or different ways, for company innovate, which are shown in Table 3. These are: offerings (what), platform, solutions, customers (who), customer experience, value capture, process (how), organization, supply chain, presence (where), networking and brand. The Innovation Radar appears as a comprehensive model for identifying innovations dimensions and it is used as a reference in this research work.

DIMENSION	*DEFINITION*
Offering (what)	Develop innovative new products or services
Platform	Use common components or building blocks to create derivative offerings
Solution	Create integrated and customized offerings that solve end-to-end customer problems
Customers (who)	Discover unmet customer needs or identify underserved customer segments
Customers Experience	Redesign customer interactions across all touch points and all moments of contact
Value Capture	Redefine how company gets paid or create innovative new revenue streams
Processes (how)	Redesign core operating processes to improve efficiency and effectiveness
Organization	Change form, function or activity scope of the firm
Supply Chain	Think differently about sourcing and fulfillment
Presence (where)	Create new distribution channels or innovative points of presence, including the places where offerings can be bought or used by customers
Networking	Create network-centric intelligent and integrated offerings
Brand	Leverage a brand into new domains

Table 3 – The twelve dimensions of innovation (Sawhwey *et al*, 2006)

Table 4 depicts the innovation dimensions viewpoints of the four innovation models studied, showing their similarities and differences. The Innovation Radar model is taken as a reference for the comparison, once it is more comprehensive, with 12 possible dimensions for a company to innovate (SAWHNEY *ET AL*., 2006). It is shown a comparison between the different innovation understanding, or definitions for each dimension, stressing in the horizontal lines the similarity or convergence between these four models (each line represents a innovation dimension).

Schumpeter	*Berreyre*	*Oslo Manual*	*Innovation Radar*
Products	Technological Domain	Products	Offering
New production methods	Technological Domain	Process	Process
New raw material sources	Technological Domain		Supply Chain
	Commercial Domain Institutional Domain	Organization	Organization
New Markets and New Market structure	Commercial Domain	Marketing; New Market; New Channels Offers customization Brand Management Costumer Relationship	Presence Solutions Brand Costumer Experience
			Costumers Value Capture Networking Platform

Table 4 – Innovation dimensions viewpoints from innovation models

In accepting the existence of different innovation dimensions, companies can define what dimensions are more appropriate for promoting or evaluating innovation, or eventually analyze how innovative they are in each dimension (SAWHNEY *ET AL*., 2006).

Measuring innovation by indicators

Due to its nature, innovation measuring or evaluation is not a straightforward process. Usually innovation is evaluated by the company's results. The application of qualitative indicators, although valid in some situations, usually provides more intuitive results (SBRAGIA, 1992). The Oslo Manual addresses the application of indicators qualifies the innovation evaluation process, and considers them as crucial in this process (OCDE, 2005). However, the Oslo Manual does not present a specific group of recommended indicators for measuring innovation or R&D.

Some indicators usually applied for evaluating R&D, and more recently suggested to measuring innovation are related to number of patents, published papers, costs reductions, research projects versus new products, company raking in the market, etc. (ZEN, 2007). In this work, the application of indicators was also analyzed.

III- Research methodology and results

Research referential

Figure 8 depicts an overall idea of the methodology used. Based on the concepts of creativity, invention and innovation presented in the literature was established one of the referential of this research. This was complemented by the dimensions of innovation. In order to understand how innovation is being measured by "real world", 35 innovation awards were selected and analyzed. Based on these innovation awards a set of evaluation innovation criteria were analyzed resulting in the second referential of this research. Based on this, a comparison was realized between these two referentials. The research has looked also more deeply a specific Brazilian Innovation Award (FINEP), which will be discussed in the context of a future paper.

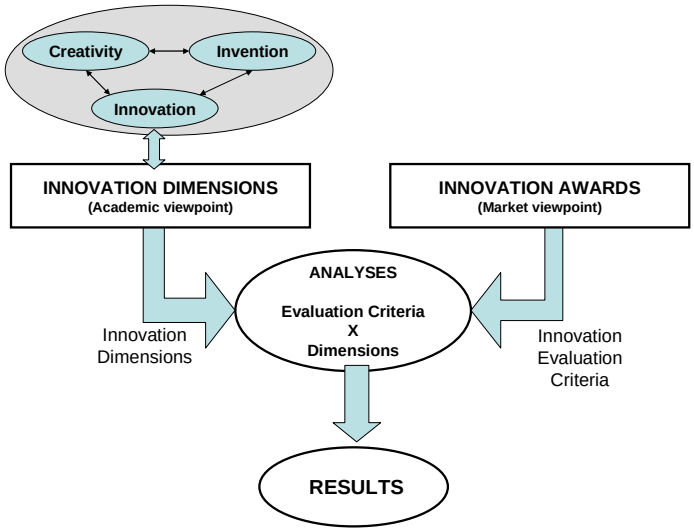


Figure 8 – Representation of the research methodology

Innovation awards identification

For the identification of the innovation awards internet search engines, such as Google and Altavista, were used. Innovation awards from different nature, countries, economic segments, etc., were identified. Some criteria were used for selecting the innovation awards, as for example, the awards publication should be from 2004 to now, and in English or Portuguese.

Based on this, firstly, a quantitative analysis were performed identifying main characteristics of these awards, such as: origin, public domain, activity and economic sectors, types of criteria (objective or subjective), questioner's structure, etc. After that, a qualitative analysis was realized identifying the presence of the twelve innovation dimensions on the innovation awards. This was realized based on the pieces of information present in each innovation award (questioner, rules, judgment criteria, etc.).

Figure 9 shows the distribution of the innovation awards selected around the globe, where 74,3% (26 awards) are from USA (14), Canada (4) and UK (8). 25,7% awards are distributed around 8 countries. Figure 10 depicts the innovation awards distribution by economic sectors, where most of them, i.e. 28 awards, are focused on services sector and 6 awards on the industrial sector.

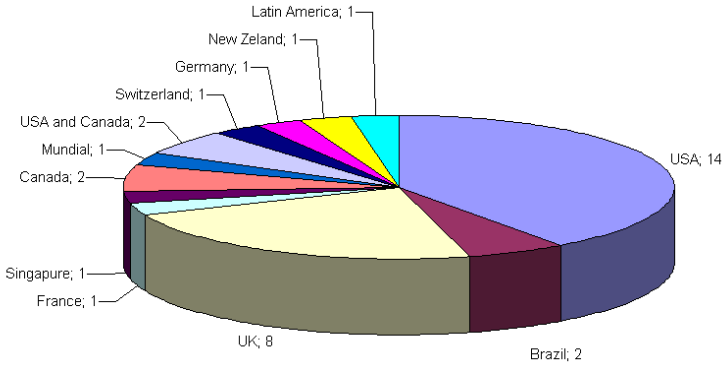


Figure 9 – Innovation awards distribution around the globe

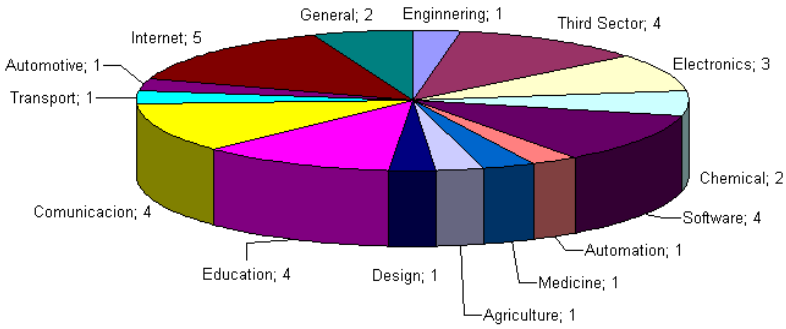


Figure 10 – Innovation awards distribution by main economic sector

Figure 11 shows the indicators judgment criteria (objective and subjective) identified in the innovation awards analyzed. The analysis has shown that 31,4% (11 awards) have at least one objective indicator. On the other hand, 66% (23 awards) have subjective indicators for their evaluation process, which can be related with the lack of structured questioners. In 71,4% (25 awards) no structured questioners were used. In only one award the judgment is realized by direct election.

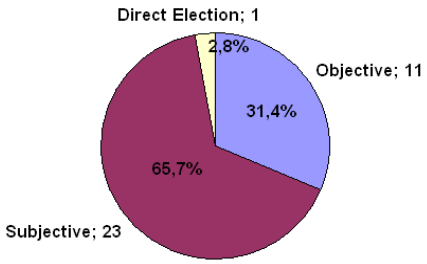


Figure 11 – Judgment criteria characteristics

Figure 12 depicts the invention and diffusion presence on the innovation awards criteria. In 22 awards both concepts, i.e. invention and diffusion, are considered within their jugdment criteria. In 32 awards the invention concept is considered, while that in 24 awards the diffusion aspects is considered.

Emphasis to	Yes	No
Invention	32	2
Diffusion	24	10
Invent. & Diffus.	22	1

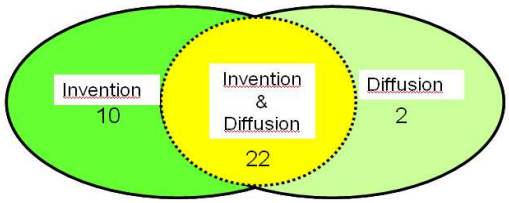


Figure 12 – Invention and diffusion presence on innovation criteria

Analyzing Innovation Awards against Innovation Dimensions

Based on the analyses performed in each one of the 35 innovation awards, another analysis was performed showing in which level these innovation awards make reference to the 12 dimensions of innovation.

Figure 13 shows each innovation dimension and in how many innovation awards they appear. The major incidence was in Process, Offering, Solutions and Organizations. Also, it can be observed that all 35 awards together make reference to the maximum 8 of 12 innovation dimensions (Figure 14), which shows differences in the way of identifying and evaluating innovative companies.

Innovation Dimensions	*Awards (quantity)*	*% (of 35)*
Process	**28**	**80,00%**
Offering	**28**	**80,00%**
Solutions	**13**	**37,14%**
Organization	**9**	**25,71%**
Customers	**2**	**5,71%**
Customer Experience	**1**	**2,86%**
Presence	**1**	**2,86%**
Platform	0	0,00%
Supply chain	**1**	**2,86%**
Networking	0	0,00%
Value Capture	0	0,00%
Brand	0	0,00%

Figure 13 – Incidence of innovation awards in each innovation dimensions

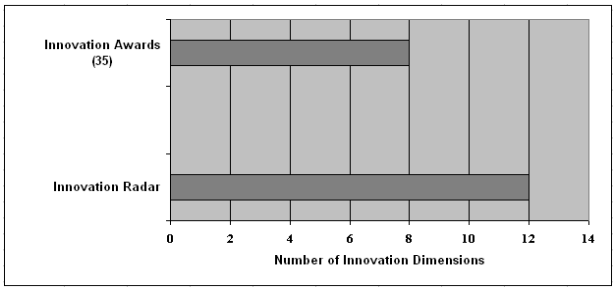


Figure 14 – Innovation Dimensions: Radar *versus* Awards

IV- Conclusions

This work shows complementary ways of identifying innovation, from Schumpeter, Oslo Manual to a more recent viewpoint presented by the Innovation Radar. Twelve innovation dimensions were defined as a reference model to compare with innovation awards identified in the internet. The research has corroborated that in order to measure innovation particular understanding and domains must be defined.

The concepts of innovation and diffusion were identified in most of the awards. The confront of innovation dimensions with innovation awards has shown that the way of assessing innovation is still restricted, being focused mainly in product (offering), process, solutions and organization. Also, in most of these awards the judgment criteria indicators are subjectives. The use of structured questioner was identified in few awards.

Further work is required in extending the understanding of innovation dimensions as criteria for innovation awards. It is necessary to expand the research for others awards from different areas, languages, countries, societies, etc. Also, a more impartial (objective) way of analyzing the innovation award dimensions and criteria is required, providing a “kind of” best practices on innovation awards.

References

CRUCIO, Luiz Antônio; O processo da inovação em pequena empresa. Dissertação de mestrado, programa de pós-graduação. Porto Alegre: UFRGS, 2003.

DACORSO, Antônio L. R. e YU, Abraham Sin Oih*. Inovação e risco na pequena empresa (Innovation and risks in small enterprises).* In: Scragia, R. e Stal E. Tecnologia e inovação: experiência de gestão na micro e pequena empresa. São Paulo: PGT/USP, 2002

FALLON, Pat e SENN Fred. Juicing the orange. Harvard Business School Press, 2006.

GASSE, Y. and CARRIER, C. Gérer la croissance de as PME, Montreal. Les editions de l´entrepreneur. 1992.

HAMEL, Gary. A obrigação de inovar. Argentina; HSM Management, ed. 31, mar/abr, 2002, p. 35-40.

KOTLER, Philip. Marketing de A a Z: 80 conceitos que todo o profissional precisa saber. Rio de janeiro: Elselvier, 2003.

OECD, Organization for Economic Co-operation and Development. Proposed Guidelines for Collecting and Interpreting Technological Innovation Data – Oslo Manual. 3th Ed. 2005.

OLEA, Pelayo M. Aproximacion conceptual al proceso de la innovacion. Tese doutoral. Escola Superior d’Enginyeria Industrial de Barcelona (ETSEIB). Universitat Politécnica de catalunya (UCP), 2001.

PORTER, M. E. On competition, Harvard Business Review, nov/dez, cap. 2, p.46-82, 1996.

ROGERS, E.M. Diffusion of innovation, 5ª. Ed, New York, Free Press, 1995

ROTHWELL, R. Industrial innovation: success, strategy, trends. In Dodgson, M., Rothwell, R. The handbook of industrial innovation. Cheltenham, Edward Elgar, 1995

SAWHNEY, M., WOLCOTT, R.C, ARRONIZ, I. The12 different ways for companies to innovate. MITSloan Management Review, Massachusetts Institute of Technology, p.75-81. V. 47(3). Spring, 2006.

SCHUMPETER, J.A. The theory of economic development. A teoria do desenvolvimento econômico: uma investigação sobre lucros, capital, crédito, juro e ciclo econômico. São Paulo: Nova Cultural, 1985 (1934).

SENGE, Peter e DRUCKER, Peter. Mentes que brilham. HSM Management, ed. 31, mar/abr, 2002, p. 16-24.

Patent based analysis of Technology Maps for Innovation Management and Research Planning

E. Sani[1,*], E. Ruffaldi[1], M.Bergamasco[1]

[1] Scuola Superiore Sant'Anna, Pisa, Italy

* Corresponding author: e.sani@sssup.it

Abstract: Innovation management and research directions planning are challenged by the understanding of the technology space in which an entity is placed. In particular, it is necessary to understand the relationships of the patent portfolio with the respect to competitors. Patent databases provide useful information for exploring a given technology area, but only when they are being properly analyzed are able to provide fruitful insights. The approach of technology trajectories can be extended toward the creation of an intuitive technology map. This paper presents an interactive approach to the exploration of technology space based on patents. Patents are being analyzed using the citation graphs generating a technology map that presents the technology topics on a landscape, displaying the patent density and the main actors in the area. The map is interactively displayed allowing the user to focus on specific patents or companies. Finally, a specific case study is provided presenting the application of this approach focusing on the area of rehabilitation.

Keywords: patent; citation, technology mapping; research planning; patinformatics

I- Introduction

Nowadays if a firm wants to lead the market and take advantage of its positioning, it has to exploit the same information about technology that are shared among other competitors. Private agents standing out the market and profit-seeking allocate specific resources for exploring and developing new products or technologies they suppose to be promising. If they succeed in doing it, their production costs, market position, competitors, and clients will be affected by such innovative techniques. In some cases, the way things go has negative sign and the consequences may be severe. As well known, the New Product Development process is a time and cost consuming component and there is a lot of sense in considering the information technology as an enabling tool for improving the effectiveness of management operations and management strategic decision. Indeed, from a business point of view, research is a risky and expensive activity, that may or may not provide exploitable results; it is undertaken especially when it is not strategically wise to achieve the same technology with different policies (licensing, cross-licensing, etc.). The main result of industrial research is the patent, being the official and formal way of innovation protection. The patent portfolio represents one of the key assets especially for high technology companies, and it can be adopted for several business goals (e.g. keeping market position, supporting profitable agreements, protecting current, future products). In the context of patents and the related licensing, exhaustive surveys are mainly focused on the adoption of innovative technologies, and the related economic impact, without identifying the primary causes of such innovation (Rosenberg, 1982) or identifying critical path analysis. It is indeed interesting to study possible paths that can be generated once having analysed patent samples and their relationships in a given area. Following this trend, recent studies try to verify the theory of invention (Fleming, Sorenson 2001) following the Kauffman's work (Kauffman, 1993) based on evolutionary biology. Kauffman focused his analysis considering the role of complexity in adaptive systems and assuming the existence of a landscape in which superior organisms can seek superior levels of biological fitness. This metaphor can be interpreted in the sense that, the stronger is an innovative technology on a market, the higher is the likelihood to establish fruitful collaborations and agreements with third parties. Along the lines of this, further studies demonstrate that technologies follow a sort of 'technological life-cycle' (Abernathy 1978, Anderson 1990) and further else that technologies go beyond different periods of equilibrium broken in unsteady ones (Eldredge, Gould 1972).

This paper focuses on technology innovation management and research directions planning as an interesting tool for a strategic understanding of the technology space of given entities in a given area. Following on from a brief literature review of patent analysis, research planning,

roadmapping and technology trajectories, this work focuses on describing the methodology adopted. A case study is represented showing the application of the technology mapping process on specific fields of technologies related to rehabilitation.

II- Research background

II.i Patent analysis applications

The tools for Intellectual Property analysis, open to business R&D departments as well as to University Technology Transfer Offices (TTOs), improved along time both in qualitative and quantitative aspects. These tools allow to retrieve patents and search among the relationships of patents, but they do not provide a detailed content and cross referenced based search. The opportunity offered by more intelligent text analysis algorithm, integrated with domain knowledge bases, allows the creation of new tools for the analysis of IP material. These new tools, based on citation networks and semantic analysis, let discover relationships between patents and new patents previously hidden. Some analysis tools are already available for helping and structuring the clear placement of the company with the respect to the outside market as well as for identifying future directions, based on the information sourcing in public database of patents (Jenkins, 2001), although there is space for more interesting analysis. As pointed out by other researchers, since inventors probably limit their patent applications to their more successful inventions, patents presumably represent only the higher tops on conceivable and potential landscapes (Fleming, 2001). Nevertheless, the number of citations a patent receives is strictly and positively correlated with its technological relevance (Hall, 2000), (Albert 1991) and may also be tightly connected with the social value, representing a measure of the inventive usefulness across heterogeneous and different technologies fields (Fleming, 2004). The proposed analysis focuses on patents and patents citations as a measurement of the current trends of a specific technological scientific innovation useful also for analyzing specific technologies niches (Sani, 2007).

II.ii Technology trajectories as a complex informative landscape

The evolution of technologies in a given area is an important step in the understanding of a company placement and in the identification of possible future directions. In particular, the concept of technology trajectories (Dosi 1982) has been introduced to formalize and present the major lines of the evolution of technologies; a technology trajectory can indeed be represented as a path that, among the various possible paths of technological solutions, has been successful in a given area along time. This type of analysis has been successfully applied to a variety of fields, and it has been primarily based on the use of patent citations (Helo, 2003), (Verspagen 2007), (Martinelli 2008). The quantitative results provided by this type of analysis are shown in the form of graphs with bifurcation when there are several technological alternatives. In this way it is interesting to identify and study solutions that have been discarded or others that could be promising. The insights provided by technology trajectories are extremely useful in the understanding of the general trend of a technological field, but for a deeper analysis it is necessary to use more advanced types of visualizations that can provide more complete and detailed scenarios.

In particular an interesting technique for presenting a domain of data or a complex data set is the landscape visualization in which abstract data is represented as a map (Boyack 2002). Specifically, technology maps are able to represent the major relationships between technologies and the positions of different competitors in this landscape (Rinne 2004). These maps can be constructed based on textual information, as in data mining and topic maps (Boyack, 2001), or based on the citation associated to documents (Brandes, 2002). The adoption of landscape requires anyway some care because 3D visualization is not guaranteed to provide a better understanding of a problem (Tory, 2007). The other important aspect that should be taken into account in the landscape visualization is the time component; it represents the evolution of the patents and technology along time (Huang Z. et al. 2003).

This paper bases the innovation management approach on the creation of technology maps that allow to interactively understand the position of a company with the respect to current trend of technologies, as they can be obtained from patent information.

III- Methodology

The proposed approach uses the information extracted from a given patent set to create a technology map that can be explored for understanding the technology landscape along time. The phases from the patent data to the map are the following:

1) Construction of the patent set
2) Computation of the citation graph
3) 2D Layout of the citation graph
4) Analysis of areas and portfolios
5) Creation of the landscape

The patent set is currently created during a first phase of the analysis, although it could be performed incrementally while the map is being created. This creation phase starts from a elementary query in the patent database, or simply by selecting a group of well known patents. This initial set is extended first by extending the search to the International Patent Class (IPC) subclasses of this initial patent set, eventually using specific keywords contained in the abstract and in the body of the initial set. Finally, the set is extended by recursively traversing the citations network of the patents, using various criteria as a stopping condition. Once the patent set has been obtained, it is important to normalize the contained data and to aggregate the duplicate entries. In many cases, indeed, the same patent is found in multiple versions or databases, or the broad search provides results in patents belonging to the same family. After that, it is assumed to not modify the patent set, and for this reason, every patent is associated with an index in the patent set. In Information Retrieval terminology the patent is equivalent to a document and the patent set is the database.

The method applied for the analysis and the visualization of patent data is twofold. One part of the analysis involves the use of the citation graph, that is the network of citations among patents, while the second part is based on text mining techniques applied on the patent text. The citation graph can be considered as a flow of information from older patents to newest ones; such a flow is reversed with the respect to the citations direction. The graph is represented by an adjacency matrix C, in which the element i,j is set to one when the information flows from the patent at position i to the patent at position j. From the matrix C is possible to build the reachability matrix R, that informs us if a patent i is connected some way to a patent j. From this matrix it is possible to identify the disjoint components of the patent set, that are single patents or group of patents that are separate from others. Such components cannot be connected using the citation analysis. The integration of text based techniques allow to compute distances respect these components.

Finally, we distinguish patent depending on their information flow: a source is a patent that is not receiving information while a sink is a patent that only receives information. The citation graph analysis allows to capture the major structures in the citation network, and for this purpose we are adopting the algorithm of Search Path Link Count (SPLC) as introduced by (Hummond and Doreian, 1989) and used by (Verspagen 2007) for patent analysis. The SPLC of an edge in the citation graph is the number of shortest paths from all sources to all sinks that pass over a given edge: this is equivalent to identifying the most common citations among all the ones in the citation space. The SPLC is typically used for computing the main path in the trajectory that is the most relevant trend in the network, based on this type of weighting. The objective of this work, anyway, is the identification of the different technological trends. The approach followed in this work is based on the iterative computation of the main paths, at every step a main path is computed and then all the associated weights are removed from the network. The resulting paths are representative of different topics. Each topic can be analyzed by building a sub-network of the patents relative associated to the main path. This sub-network can be built by propagating the patents involved in the network following the flow of information up to a certain level.

The trajectory path provides the fundamental structure of the citation graph and it is used for creating the core layout of the patent set, using force directed algorithms like Fruchterman-Reingold. The 2D layout is being transformed into a 3D surface mapping the density of patents in a given area to the height. The computation of the height from the single patent data is performed using Radial Basis Functions (RBF): ever patent is a center of a template surface, typically a Gaussian, and the surface is obtained by the superimposition of all these surfaces. The alternative to this process is an interpolation based on triangulation of the point, that for unevenly spaced points like the patents in the layout generates surfaces that are not sufficiently smooth for the interactive exploration. The color of the landscape represent also the density supporting the information provided by the height. The metaphor of the landscape is augmented with the display of the trajectories as curved lines over the landscape, showing the different relevant regions.

The relationship between players in a given topic is obtained by analyzing the assignee field of the patent data. In the cleaning phase the names of the assignees are normalized for making sure of selecting research institution and companies. In this way each assignee identifies a different cluster of the citation graph, and in addition it is possible to use the 2D layout information for measure the distance of a patent portfolio respect the main path. Assuming that the top path is a good representation for the trend in an area it is possible to evaluate the distance of a firm respect the path, and estimate this trend along time (Martinelli 2008).

In terms of implementation the patent set is obtained from esp@cenet and USPTO and later processed with MATLAB. The layout is performed using Force Directed Placement initially based on Graphviz and then re-implemented for exploiting the parallelism of Graphical Processing Unit (GPU). The interactive visualization in 3D is based on MATLAB, allowing a fast prototyping of the interaction.

IV- Case study

This paper talks about technology mapping on specific fields of technologies related to rehabilitation. In particular we started from a preliminary query on patents in the IPC class A61 containing the word prefix *rehab* in the title and in the abstract, from US and EU databases. This starting set, after duplication removal contained 622 patents. The second phase of the data extraction has been based on the recursive retrieval of patent following the citation graphs, giving 10463 patents after two level recursion, and 3851 with one level recursion. This investigation is based on the set of 10463 patents that are organized in 31 disconnected components. The largest component contains the 97% of the patents, while the others contain between 2 and 36 patents. In this analysis we are going to focus on the biggest component of 10212 patents. In terms of time the period covered by the patent set is from 1967 to 2005.

The major trajectories computed with SPLC are:

1. from simple hearing aids to rehabilitation of hearing (1973-2000)

2. from basic knee brace to anatomically and neurophysilogically designed knee braces (1976-2003)

3. electric surgical instruments (1975-2004)

For example the first trajectory in the main component of this set is associated to the following patents:

Patent	Year	Title
US3764748	1973	IMPLANTED HEARING AIDS
US3870832	1975	IMPLANTABLE ELECTROMAGNETIC HEARING AID
US4352960	1982	Magnetic transcutaneous mount for external device of an associated implant
US4606329	1986	Implantable electromagnetic middle-ear bone-conduction hearing aid device

US4817607	1989	Magnetic ossicular replacement prosthesis
US4936305	1990	Shielded magnetic assembly for use with a hearing aid
US5163957	1992	Ossicular prosthesis for mounting magnet
US5259032	1993	Contact transducer assembly for hearing devices
US5554096	1996	Implantable electromagnetic hearing transducer
US5772575	1998	Implantable hearing aid
US5941814	1999	Arrangement for adjusting and fixing the relative position of two components of an active or passive hearing implant
US6077215	2000	Method for coupling an electromechanical transducer of an implantable hearing aid or tinnitus masker to a middle ear ossicle
US6682472	1999	Tinnitus rehabilitation device and method

The first simplification of the network, useful for understanding the overall scenario is based on the selection of the patents that can be reached from main paths with only a given number of steps, or based on a threshold in the link count. From the 37 patents in the three disjoint main paths the network reachable in 3 steps is made of 1132 patents, but this reduction is not sufficiently good because it selects not relevant patents. If instead the above selection is reduced by introducing a threshold of 0.0005 in the weight the resulting network of 232 patents has less noise and the resulting layout can be better understood.

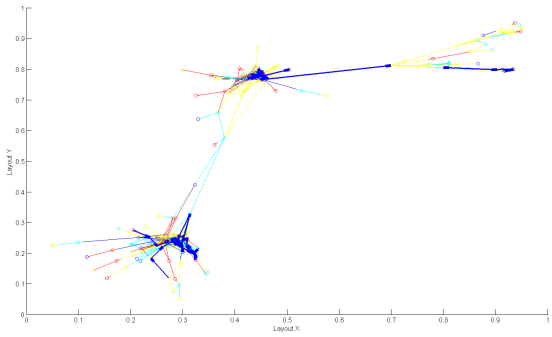


Figure 15 Graph of the reduced network highlighting the three major topics in the patent set, obtained from the three main trajectory and then extended by propagation. Patents and citations are shown as circles colored by distance from the main paths, while the main paths are colored in bold blue.

The second phase of the analysis is related to the identification of the major actors involved in the topic, based on the assignee information. After normalization and removal of assignees with less than 4 patents, the result is of 242 with a mean of patent for each assignee of 6. Examples of top assignees are MedTronic (139), Siemens (42) and Kendall (31).

IV.i Hearing Devices

In this topic there are 5 major assignees in the main trajectory of 15 patents, while there are 75 in the overall sub-network. For each assignee it is possible to compute the evolution of its portfolio along time based on the reciprocal of the geodesic distance of every patent with the respect to the main path. The evolution of the best 5 assignees along time is shown in Figure 2.

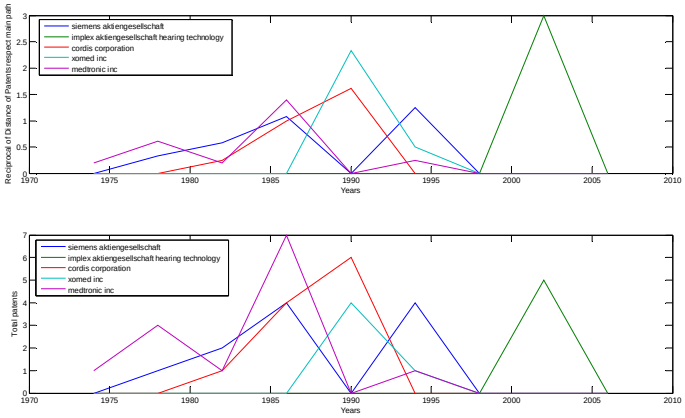


Figure 16 Evolution of the portfolios of the 5 most relevant companies in the topic. The upper plot shows the distance of patents respect the main path, while the lower shows the total number of patents in the topic. Note that the Xomed company has merged into MedTronic on 1999.

For investigating in detail this topic we built a sub-network by propagation up to 5 levels creating a sub-networks of 592 patents. The information from the citation relationships and the company portfolio can been integrated in a synthetic view presented in the form of map (Figure 3). The map presented in Figure 3 has been obtained first by generating a force directed layout of the sub-network and then using the density of patents for representing height and color.

The interactive aspect of the tool used for this work is in the possibility of zooming in and out the map, selecting single patents for obtaining information like title and year and highlighting different trajectories and assignees.

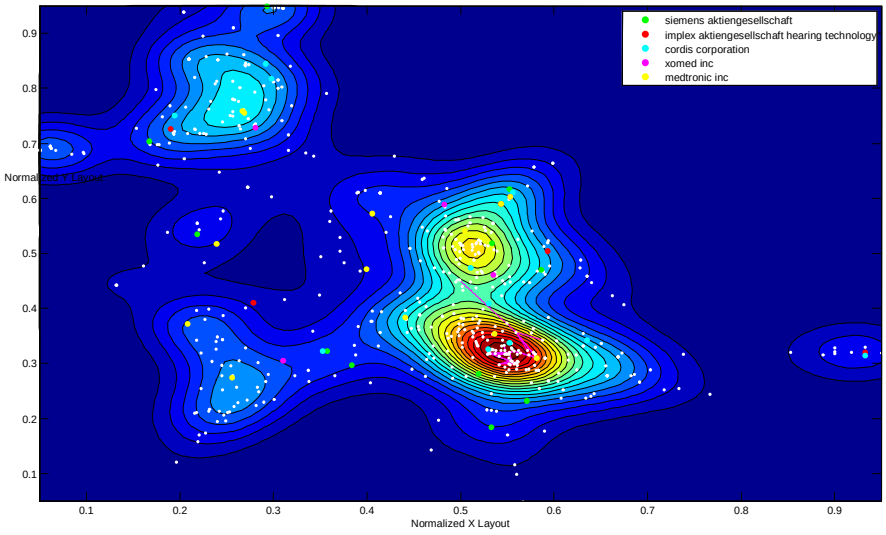


Figure 17 The map of the patent sub-network in the area of hearing rehabilitation devices. The single patents have been placed over the map as white dots for generic patents, or with colored dots for one of the 5 most relevant companies. Finally the main path has been highlighted in purple. The central isle in red is the one associated by the topic of hearing device while the smaller isles are relative to supporting technologies like electronic interfaces, implanting or

measurements. For example the rightmost island is related to implants and this is the reason why Cordis has some relevance there.

IV.ii Knee Braces

The main trajectory of this topic is made of 13 patents and the propagated network at three levels contains about 800 patents. When looking at the map associated to this network it is possible to identify the core of the main path and then some related topics about exercising device and posture control (Figure 4).

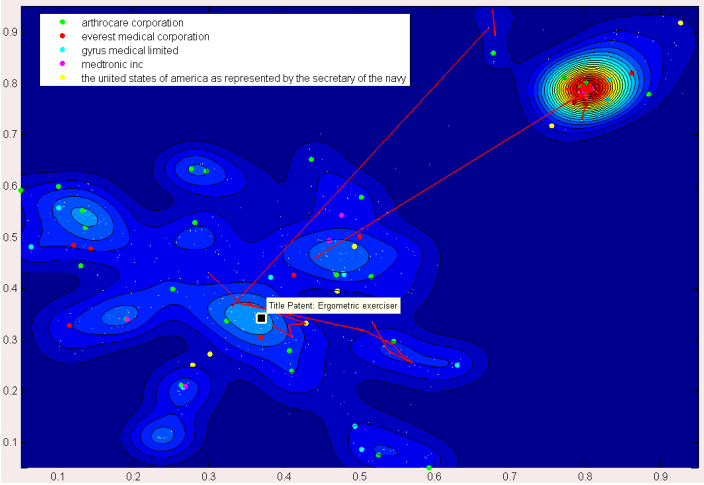


Figure 18 Map of the sub-network generated by the topic of the second trajectory. This figure has been taken from the interactive tool while obtaining information about a specific patent. In the upper left part the core of the topic is present while in the lower left there are associated technologies

In terms of evolution along time this topic has received more attention than the other in recent years, and in particular there is a strong set of patents near the main trajectory, associated to new companies as Arthrocare (1998) and Gyrus Medical (Figure 5).

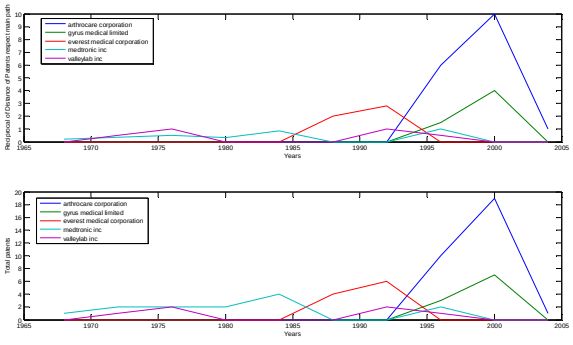


Figure 19 Evolution map of major players in the area of knee braces, with the same type of plot as Figure 2. This plot shows how two recent companies have a strong role in the trajectory associated to this topic.

V- Main conclusions

This work introduces a methodology for the visualization and exploration of a patent landscape based on the analysis of citation networks of patents and the extraction of the major trajectories. The integration of term-based analysis of patents' texts will provide an approach for the visualization of the surface in alternative to the layout based on the citation graph.

The main limitation of this work is related to the fact that patent analysis covers only the technology patented discarding the ones that are not protected or the minor inventions. In the second place, due to procedural reasons there is a gap based on the Priority Date along with the Publication Date: the former represents the first date of filing of each patent, while the latter is the first public disclosure of the patent itself. This causes a delay in the identification of a possible interested new technology.

References

Abernathy W., Utterback J. (1978) Patterns of industrial innovation. Technology Review June, 40-47

Albert M., Avery D., Narin F., McAllister P. (1991) Direct validation of citation counts as indicators of industrially important patents. Research policy 20, 251-259

Anderson P., Tushman M.L., (1990) Technological Discontinuities and Dominant Designs: A Cyclical Model of Technological Change. Administrative Science Quarterly, 35

Boyack K., Wylie B. & Davidson G. (2002), Domain visualization using VxInsight for science and technology management. Journal of the American Society for Information Science and Technology, 53, 764-774

Dosi, G. (1982) Technological Paradigms and Technological Trajectories: A Suggested Interpretation of the Determinants and Directions of Technical Change Research Policy, 11, pp. 147-162

Eldredge N., Gould S. (1972) Punctuated equilibria: an alternative to phyletic gradualism. In: Schopf, T. (Ed), Models in Paleobiology, Freeman, San Francisco, CA

Fleming L., Sorenson O. (2001) Technology as a complex adaptive system: evidence from patent data. Research Policy 30, 1019-1039

Fleming L., Sorenson O. (2004) Science as a map in technology search. Strategic Management Journal, Volume 25, Issue 8-9, 909-928

Grupp, H. & Schmoch, U. (1992) Perceptions of scientification of innovation as measured by referencing between patents and papers: dynamics in science-based fields of technology Dynamics of Science-Based Innovation, Springer Verlag

Hall B., Jaffe A., Trajtenberg M., (2000) Market Value and Patent Citations, NBER working paper series, ISSU 7741

Helo, P. (2003), Technology trajectories in mobile telecommunications: analysis of structure and speed of development International Journal of Mobile Communications, Inderscience Publishers Ltd, 1, pp. 233-246

Huang Z., Chen H., Yip A., Ng G., Guo F., Chen Z.K., Roco M.C, (2003), Longitudinal Patent Analysis for Nanoscale Science and Engineering: Country, Institution and Technology Field. Journal of Nanoparticle Research, 5, 3, 333-363

Hummond, N. P. & Doreain, P. (1989), Connectivity in a citation network: the development of DNA theory, Social Network 11, 39–63

Kauffman S. (1993) The origins of Order: self-organisation and selection in evolution. Oxford University Press, New York

Martinelli, A. (2008) Technological trajectories and Industry evolution: The case of the Telecom Switching Industry. DRUID-DIME Accademy PhD Conference

Rinne M., (2004) Technology roadmaps: Infrastructure for innovation, Technological Forecasting & Social Change, Elsevier, 2004, 71, 67-80

Rosenberg N. (1982) Inside the Black Box: Technology and Economic Change. Cambridge University Press, New York

Sani E., Frisoli A., Bergamasco M. (2007), Patent based analysis of innovative rehabilitation technologies, Virtual Rehabilitation, IEEE, 27-29 Sept. 96-101

Tory M., Sprague D., Wu, F., So, W. & Munzner T. (2007), Spatialization Design: Comparing Points and Landscapes. IEEE TRANSACTIONS ON VISUALIZATION AND COMPUTER GRAPHICS, IEEE Computer Society, 2007, 1262-1269

Verspagen, B. (2007) Mapping Technological Trajectories as Patent Citation Networks. A Study on the History of Fuel Cell Research, Advances in Complex Systems, 10, pp. 93-115

Developing a participative idea generation technique – mapping pedagogy of innovation

A. Pässilä*, A. Paalanen

Lappeenranta University of Technology, Lahti Unit, Finland

* Corresponding author: anne.passila@lut.fi, Tel. +358 3 876 910

Abstract: There is somewhat unused potential in the design of new participatory and dialogical techniques for industrial companies to enhance their innovative capability. Different approaches to pedagogy are based on the major trends of Western philosophy. Pedagogy has been broadly linked to a positivistic and phenomenological approach. But are human beings so rational in a postmodern culture? We claim that an interpretative pedagogical approach has plenty to offer to the field of engineering in finding new ways to innovate. The goal of interpretative innovation is to discover new meanings. Interpretative innovation process is a multi-voiced process of dialogue which emphasizes interaction and communication among people. The study combines the interpretative approach to a traditional industrial context. A new idea generation technique is being developed as a part of a participative action research process. A model for interpretative idea generation technique is presented.

Keywords: Interpretative innovation, Constructive pedagogy, Idea generation technique, Traditional industry

I- Introduction

There is a somewhat unused potential in the design of new participatory and dialogical techniques for industrial companies to enhance their innovative capability. Currently different approaches to pedagogy are based on the major trends of Western philosophy divided into three philosophical approaches; positivistic, hermeneutics and Marxist. Learning through innovation context has been broadly linked to a positivistic approach and to an interpretative approach. In a traditional engineering field human beings are seen in a tayloristic way; human actions are believed to be rational and human functions are described as linear. They can be controlled and changed through training. The learning of the individual aims at growing the wealth of the company. (Uhlin 2000, Lester & Piore 2004)

But are human beings so rational in a postmodern culture? From the perspective of *interpretative based* learning processes the unrealistic expectation of rationality can result in the fact that different types of training do not reflect on innovation ideas and the innovation capability of an organisation. Human functions should be approached as a complex system in situated context. In this context interpretation is understood as a fragmented, situated, ongoing and open-ended learning process in which the beliefs, habits, practices, traditions and learning of a worker in an organisation are deeply intertwined. (Rhodes 1996, Weick 2001, Lester & Piore 2004, Lave & Wenger 1991, Vince 2002) We, as a researchers had Weick in our mind when we formulated our question; could idea generation techniques thus be used so that human beings construct their experienced reality through shared interpretation of meanings?

If an organisation's internal communication is the basis of innovation (Schein 1996), it is imperative to involve the workers in an enriching dialogue (Buber 1923/1993). However, mental blocks and various distances often slow creative and renewed thinking down, for example cognitive distance between the innovating partners (Zhang et al. 2005: 34; Parjanen et al. draft). These can be reduced by designing a technique that encourages all employees to join innovation process and shared meaning making. When designing a new technique for generating ideas for innovation it must support an atmosphere that nourishes trust and creativity (Csikszentmihalyi 1996, Gustavsen 1996, Harmaakorpi & Melkas 2005). Also, shared learning context and the activation of reflective thinking help the dialogue to arise.

The participative methods aim at developing critical, reflective and playful thinking, both individually and collectively. (Mezirov 1996) From the socio-cultural point of view, thinking is also a collective process happening between and within people. The dialogue is held together

when giving and receiving meanings. The key factor in this learning process is collective growth of common and shared understanding (Säljö 2001: 108-109.) A game-like technique refers to certain structure of learning and shapes the learning event. By bringing this "open" and "unfinished" framework for learning the participants are required to have a certain state of mind. Playful or creative thinking refers to the internal imaginary process of an individual while game, on the other hand, refers to the conventions and rituals of the activities. (Gadamer 2001, Boal 1996, Darsø 2004)

First it is explained what kind of innovation is in the core following by the approach on learning. Interpretative innovation is thus combined to constructive learning approach. Second the context for the study is presented. An idea generation technique is being developed as a part of participative action research process. Third, the experiences of developing the new technique are told. The technique is being tested in the action research process with group of 12 salespersons and two managers. After trying the technique in practice, discussion section presents the model for the new idea generation technique.

II- Interpretative approach to innovation and learning

Innovation processes are constructed also with issues that cannot be 'solved' or unified in a logical linear and analytical order. According to Lester and Piore (2004) innovation processes are often studied only as rational and standard decision-making and problem-solving with its roots in engineering. Innovation is analytical and analysis is a linear project with a well-defined beginning and end. The goal is to solve problems. Lester and Piore are questioning if there is a missing dimension in innovation research and they are looking new direction from a filed of interpretation, based on cultural and communicational studies. According to them the interpretative view is not widely understood in the field of innovation, although it would provide new insights. In table 1 Lester and Piore compare analytical and interpretative approach (IA).

ANALYSIS	INTERPRETATION
• The focus is a project, with a well-defined beginning and end • The thrust is to solve problems • Managers set goals • Managers convene meetings and negotiate to resolve different viewpoints and eliminate ambiguity • Communication is the precise exchange of chunks of information	• The focus is a process, which is ongoing and open-ended • The thrust is to discover new meanings • Managers set directions • Managers invite conversations and translate to encourage different viewpoints and explore ambiguity • Communication is fluid, context-dependent, undetermined

Table 1. Comparing analysis and interpretation (Lester & Piore 2004, 97-98)

The goal of interpretative innovation is to discover new meanings. New meanings can be constructed by employees through interpretation. Interpretation is understood to be fragmented, ongoing and open-ended. It is a multi-voiced process of dialogue which emphasizes interaction and communication among people. (Lester & Piore 2004, 6-8; 97-98) Obviously this new dimension needs also new collective learning practices inside organization. That has inspired us to study together with case company's participants and innovation specialist to construct practical forum for interpretative learning.

On learning

" As there are no fixed truths or totally definitive knowledge, and because circumstances change, the human condition may be best understood as a continuous effort to negotiate contested meanings. " (Mezirow 2000, 3) Facilitating collective learning in a context of working practices is a challenging task. It is important to organize reflecting, nurturing and understanding

of diverse views in the practices of workers in industrial organizations. Learning process is often described in an idealistic and romantic way; it is described to be process of endless happiness but is it so? Vince (1998, 308) point out that complex and unequal relations around knowledge which are constructed in social action are part of the learning process. Isn't learning also chaos and hard work even if in the end of the learning process people are happy? Or is it even absurd to say that learning process has an end? According to Mezirow (2000) learning could be seen as a ways how we organize, reflect and integrate our meanings of experience in real-life situations. Contextual and situated understanding is vital in a collective learning process. Making meaning and awareness of how meaning is constructed are in a core of this kind of learning process. (Mezirow 2000, Weick 2001, Lave & Wenger 1991, Säljö 2001)

Bruner (1996) and Mezirow (2000) list five modes for identifying meaning making: 1) establishing, shaping and maintaining intersubjectivity; 2) relating events, utterances, and behavior to the action taken; 3) construing of particulars in a normative context; 4) making propositions, application of rules of the symbolic, syntactic, and conceptual systems and 5) becoming critically aware of one's own and others tacit assumptions and expectations and assessing their relevance for making an interpretation (Mezirow 2000, 4). "Learning is understood as the process of using a prior interpretation to construe a new or revised interpretation of the meaning of one's experience as a guide to future action" (Mezirow 2000, 5).

The socio-cultural approach (Säljö 2001) to learning points out that making meaning as thinking process is also a collective process happening between and within people. Especially in a context of organizational innovation capability it is vital that people have learned and constructed a culture that nourish curiosity, attraction to complexity, intuition, senses, self-understanding and critical thinking. Socio-cultural environment of organizational learning, concluding physical, technical and social systems, should be constructed so that it facilitates collective self-actualization. (Csikszentmihalyi 1996; Gustavsen 1996; Harmaakorpi & Melkas 2005). Could this kind of a learning based be constructed in to a playfulness context?

In a context of playfulness it is important to build up together a shared trustful atmosphere which should be serious and same time playful. Playfulness is constructed by using narrative techniques for structuring interactions, interrelationships and habits of people in the work environment and work community. Especially when using narrative techniques, for example myths, pictures, images and metaphors which activate non linear thinking process, helps people to gain new code for their way to communicate together. This kind of narrative techniques are based on imaginary space (Lämsä & Sintonen 2006) and language is not understood only as a text. But the shared understanding as an interpretation is made through conversation and language. These kinds of techniques aim to stimulate creativity relevant skills. This kind of a learning actions aims at bounding socio-cultural present and historical process of organization's everyday life to reconstruct the identity of organization. From this point of view learning consist actions how to renew and create organizational culture than to be socialized to present culture. (Gadamer 2001, Heikkinen 2002, Boal 1996, Heikkinen 2002, Darsø 2004)

III- How was the new technique developed?

The new technique was created as one of the research and development processes in Lahti School of Innovation. This unit of Lappeenranta University of technology has researchers from various disciplines. The driving forces of the research group are practice-based innovation, interpretative innovation and seeing the customer as a subject instead of object also in early phases of innovation process.

The idea generation technique was designed as a part of participative action research process. The research question was how to better use the scattered customer-related knowledge that different salespersons have? Figure 1 presents the different phases of action research process. The sub-questions for the technique were accumulated during data gathering, feedback and

analysis. The idea of testing a new technique was presented to the salespersons participating and their approval was acquired. The new idea generation technique was tested in action planning phase aiming to create a shared meaning for why to share customer knowledge and how to do it collectively. Action planning phase also included shaping the ideas into an action plan for the company. In this the participants took a bigger role as the roles of researchers were used mainly though mentor function.

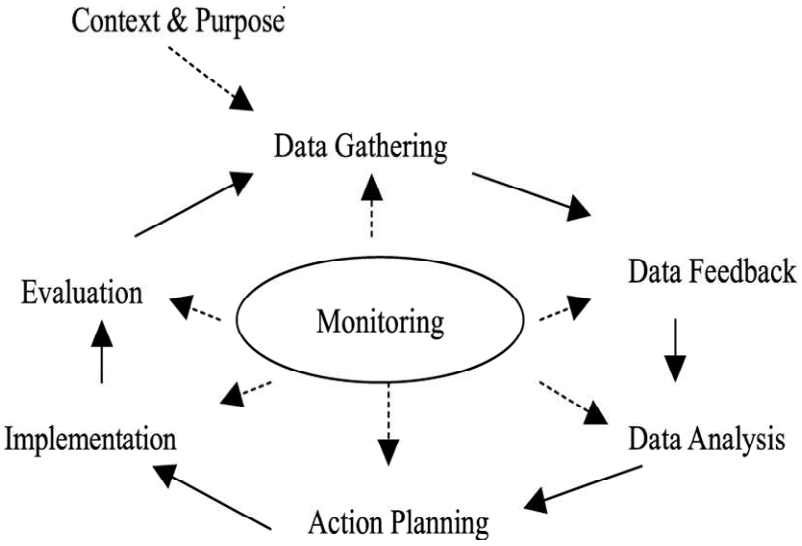


Figure 1. Action research process (Coughlan & Coghlan 2002)

An action research process is a fertile platform for developing a new technique since it combines theory and action enabling continuous feedback from practice. The design of participatory technique is linked to participatory action research that has a relationship to pedagogy which, in turn is based on socio-cultural learning. (Kemmis & McTaggart 1988, Kemmis & Wilkinson 1998, Säljö 2001)

In addition to the participative action research process, the technique was taken as a topic for one workshop among researchers. The core research group invited other researchers to take part in the workshop. Also, a specialized consultant for idea generation was invited. Altogether a group of ten multidisciplinary researchers and developers were gathered to generate the technique. After everyone had been briefed on the company's situation and the participants' questions, they were divided into four groups to generate parts of the technique. After the workshop the core research group then shaped the result into an actionable form to be used with the participants in the company.

IV- Testing the orienteering technique in practice

The technique was based on what the salespersons could do best: talking. To document this there were facilitators in every room. The participants were divided into four idea generation groups. The groups were formed in such a way that those who knew each other well, would not be in the same group. However, this could not be avoided as the whole participant group consisted of only 14 people. Figure 2 shows how the day as a whole was organised. The idea generation rooms were literally separate rooms next to each other. In every room there was target for development that needed improvement. The groups spent 30 minutes in each room and also had 5 minutes to move from room to room. After a break, every facilitator presented the ideas of their room and participants began to discuss.

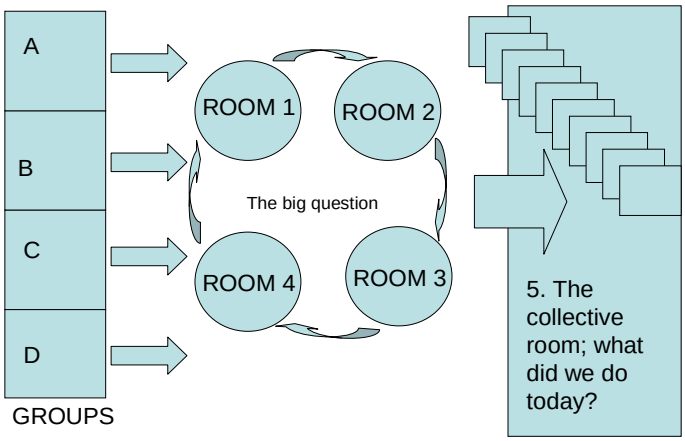


Figure 2. Testing the technique

After the first implementation round of the technique, some lessons were learned. The used rooms were relatively similar, except for one room. The four rooms need to stand out even more with separate aims and methods. It was noted that regardless of what room the group started in, the first room was the one where they were unsure as to what to do where as by the time they got to the last room; exhaustion had begun to set in. Maybe the participants should be given a chance to practice the technique, or, depending on the context it could be considered if four rooms really are necessary. Other perspective was that with different methods in different rooms the circle could be more interesting. When the technique is improved these matters should be observed.

V- Discussions

In this study, participatory and interpretative technique produced symbolic knowledge of organisations' habits and blocks beside rational and analytic knowledge. Thus, it is imperative to involve the workers in an enriching dialogue with each other. (Schein 1996) The traditional assumption that knowledge brings power to salespersons was a challenge to the study. However, the salespersons noticed that the assumption was a possible hindrance to the development of their own working environment. After recognising this, the researchers could identify that this was the learning task: how to create an collective learning space for sharing experience and information? The significance of external multidisciplinary knowledge was also stated and the deficits in competencies were revealed.

Table 2 presents the five different rooms that this idea generation technique includes. Four first are to be practiced in small groups and the fifth is a collective room. In the first room the groups form a collective vision of the wanted future. The second room focuses on the absorption of knowledge at the customer: how do different salespersons observe weak signals that can tell a lot? By revealing other's tacit assumptions on the observations some invisible barriers can be torn down. Third room makes the participants discuss the motivation to share the knowledge (More on motivational factors in Paalanen & Hyypiä 2008). Ideal situation is that the group makes a shared agreement to share knowledge in the future. Fourth room handles the knowledge inside the company; what routines aide the knowledge transfer and what practices between people makes it more fluent. Though there was an aim to generate a practice for collecting and storing customer-oriented knowledge, the actual result was not explicit. What is more important is the creation of collective meaning making among the salespersons. A shared understanding was being constructed through the different interpretations of the participants. In the future studies the technique is compared to other existing idea generation techniques. Its suitability to certain situations should also be examined.

Phase	Aim	Actions taken	Shared meanings
1. Room of visions	*A shared vision of what is meaningful for the company*	*Making a concrete collage from the pictures and discussion*	*Experiences Pictures as metaphors for the company*
2. Room of potential	*Practices at the customer; how is the knowledge absorbed?*	*Discussion, Narrations*	*Recognizing week signals at the customer*
3. Room of meaning	*Motivation to share customer knowledge*	*Discussion*	*Identity as a knowledge transferor*
4. Room of routines	*Customer knowledge inside the company*	*Discussion*	*Mutual agreements to communicate to each others*
5. Room of results	*Shared view of the four groups*	*Presentations Priorization Discussion*	*A multivoiced dialogue*

Table 2. The different rooms for the orienteering idea generation technique

The behaviour of individuals in this participatory idea generation technique can be understood by getting to know the system of scripts and schemas behind actions. The main effort was to interpret the system of meanings together with the members of the organization and thus this approach was both communicative and a dialogue in a Buberian (1923/1993) way. Workers found out that it was easier to share meanings and values through these dialogues which was stimulated by pictures, images and metaphors. According to salespersons' reflection on the process it seemed that this kind of learning process shortened the cognitive distance between the salespersons and between salespersons and managers.

Playfulness learning environment seemed to stimulate people in a physical, aesthetical, spiritual and affective level. And through this experience we success that in a fuzzy front of innovation it is more than important to familiarizes the innovation. It seemed to be too big concept and it needs interpretation by workers. Interpretation focused on exploring what does innovation means in our everyday work situations. We defined that this familiarizing had three episodes: 1) playfulness as a context to creative ideas and creative acts; 2) bridging ideas and actions from play to creativity and 3) bridging ideas and actions from creativity to idea generation practices. These episodes are constructing in a learning process which has open dramaturgy. Open dramaturgy points out that a major goal is to create expansive interpretation from the participants' experiences and this is more a case of interpretation and creating meanings (could be linked to Weick´s (2001) idea of sensemaking as a organizational action) than one of problem solving. The starting point for this kind of learning is the definition of a collectively significant working question which moves the employees. In our case study participatory techniques were tools for reconstruction of what we (we as a organization) are, where we come from, where we are adding to and how we are getting there. Learning process helped workers to see themselves as a context of innovation actions. The first push comes from the experiences of the employees themselves. But one had to realise that workers cannot be forced to reflect or interpret and even if workers are willing to interpret their interaction, learning is still polyphonic attempt to reflect chaotic flow of experiences.

Learning process in our study case company has been a living and emergent process which seamed to live its own life. It did not obey our script. In a living process all we found,

researchers as well as workers as co-researchers, how important it is to improve one's awareness about how people act as an organization and as an active subject in innovation process. The result of this participatory action based learning process was not material outcome it was more a process of self education. The results of this kind of an interpretative based learning are immaterial but practical in the sense of organization capability to see their goals, to self evaluate own actions, to understand and renew practices and be strong enough to dream future possibilities. So far we have done one round in a cycle of action research and now it is time to make a new one and learning story is to be continued. If we reflect this learning process of case study to Bruner´s and Mezirow´s five modes of meaning making, it seems that we have succeed to visit every of them. But it is not enough to do that kind of around only ones. It should not be a visit but a permanent and ongoing process. Our next step is to study and design a base for a practical and permanent program how to organize interpretative learning practices into organization's idea generation.

References

Boal, A. (1992). Games for Actors and Non-actors. Trans. by A. Jackson. London: Routledge.

Boal, A. (1995). The Rainbow of Desire. Trans. by A. Jackson. London: Routledge.

Boal, A. 1996. Politics, Education and Change. In J. O´Toole & K.Donelan (eds.) Drama, Culture and Empowerment. Brisbane:IDEA Puplications, 47–52.

Buber, M. 1923/1993. Minä ja sinä. Suom. J. Pietilä. WSOY, Helsinki.

Bruner, J. (1996). Culture of Education. Cambridge: Harvard Press.

Csikszentmihalyi, M. 1996. Creativity – Flow and the Psychology of Discovery and Invention. HarperCollins Publishers, New York.

Coughlan, P. & Coghlan, D. 2002 Action research for operations management International Journal of Operations & Production Management, Vol. 22 No 2, pp. 220-240

Darsø, L. 2004 Artful creation - Learning-Tales of Arts-in Business. Narayana Press, Denmark.

Gadamer, H-G. 2001 Truth and method. Trans. By J. Weinsheimer & D. G. Marshal. London: Sheed & Ward.

Gustavsen B. 1996 Development and the Social sciences. An uneasy relationship. In Toulmin, S. & Gustavsen, B. (eds.) Beyond Theory. Changing Organizations through Participation. John Benjamins Publishing Company, Amsterdam, 5-30.

Harmaakorpi, V. & Melkas, H. 2005 Knowledge Management in Regional Innovation Networks: The Case of Lahti, Finland. European Planning Studies, 13(5), 641-659.

Heikkinen, H. (2002). Draaman maailmat oppimisalueina: draamakasvatuksen vakava leikillisyys. Jyväskylä: Jyväskylän yliopisto.

Kemmis, S. & McTaggart, R. 1988 The Action Research Planner. Third edition. Deakin University Press.

Kemmis, S. & Wilkinson, M. 1998 Participatory action research and the study of practice. In: B.Atweh, S.Kemmis & P.Weeks (Ed.) Action research in practice, pp. 21-36. Routledge. London/ New York.

Lave, J. & Wenger, E. 1991 Situated learning. Legitimate peripheral participation. Cambridge University Press.

Lester, R. & Piore, M. 2004 Innovation the Missing Dimension. London: Harvard University Press.

Lämsä, A-M. & Sintonen, T. 2006 A Narrative Approach for Organizational Learning in a Diverse Organisation. Journal of Workplace Learning, 18(2), 106-120. Emerald Group Publishing.

Mezirow, J. 1996 Uudistava oppiminen. Kriittinen reflektio aikuiskoulutuksessa. Miktor, Helsinki.

Paalanen, A. Hyypiä, M. 2008 Enhancing employees' innovation activity through motivational factors. Proceedings of the International Conference on regional development and innovation processes, March 5-7th 2008, Porvoo, Finland.

Parjanen, S., Harmaakorpi, V. & Frantsi, T (Forthcoming) Collective Creativity and Brokerage Functions in Heavily Cross-Disciplined Innovation Processes. Submitted to Entrepreneurship & Regional Development.

Rhodes, C. 1996 Researching Organizational Change and Learning: A Narrative Approach. The Qualitative Report, Vol. 2, No 4.

Schein, E.H. 1996 Three Cultures of Management: The Key to Organizational Learning. Sloan Management Review, 38(1), 9-20.

Säljö, R. 2001 Oppimiskäytännöt. sosiokulttuurinen näkökulma. Suom. Bo Grönholm. WSOY, Helsinki.

Uhlin, Å. 2000 The Concept of Learning within the Systems of Innovation Approaches. Concepts and Transformation 5:3, p. 283-319.

Weick, K. 2001 Making Sense of the Organization. Oxford: Blackwell Business.

Vince, R. 2002 Organizing Reflection. Management Learning, 33(1), 63-78. Sage.

Vince, R. 1998 Behind and Beyond Kolb´s Learning Cycle. Journal of Management Education, 22(3), 304-319. Sage.

Zhang J., Chai K-H. & Tan K-C. 2005 Applying TRIZ to Service Conceptual Design: An Exploratory Study. Creativity and Innovation Management, 14(1), 34 – 42.

Rediscovering Telework as a tool which improves the work life balance. The case of Poste Italiane

P. Di Nicola[1,*], S. Rosati[1*]

[1] University of Rome La Sapienza, Department of Sociology and Communication, Rome, Italy

* Corresponding author: patrizio.dinicola@uniroma1.it, simona.rosati@uniroma1.it
+39.06.4991.8456

Abstract: The aim of this paper is to describe such the introduction of the EU Framework Agreement on telework and the "novel vague" of HR management which gives importance to the CSR' reputation of business, have created the conditions for a new use of telework as a tool capable of increasing the wellness of the workforce and the work life balance of employees. To argue this reflection we will illustrate, using visual sociological tools, such as video interviews to employees, middle and top managers, the telework experience at Poste Italiane, the largest Italian business. In 2007 the firm implemented a first pilot for a group of call center operators, and is, at present, expanding telework to different categories of employees: office workers, data center operators, managers.

Keywords: Organisational innovation, telework, work-life balance, Corporate social responsibility

I- Introduction

There were a time, not so long ago, in which in Italy the tale of telework seems to gain public awareness and interest. In the second half of ninenthy, in fact, in the Italian Parliament many different parties proposed laws (at a given point six projects were "on the table") intended to facilitate the diffusione of telework (even if, due to the political crisis, none of the proposals were really turned into a law). In 1997 the Government, in a decree intended to reform the working procedures in the public sector, introduced the possibility, for government employees, of using telework widely, whenever possible, as "a normal ways of working". Even in the private sectors, in the period 1993-1998, many agreements were signed, both at the firm level or at nation-wide level. But as the ninenthies were a "gold age" for telework in Italy, at the turn of the millennium the idea of telework dissolved in the public interest. This was due to many factors, but mainly to the widespread diffusion, even if in Italy with some years of delay in respect to central and north European Countries, of ICTs into all kind of workplaces. Private firms and Governmental bodies feared that introducing telework in their sites would made more complex the organisation and that telework would request some new forms of management policy. ICT, perhaps, allow the firm to use widely a "stock of implicit telework", since that many employees, took the habits of working from home in addiction to the regular office working time.

The actual situation, after the 2005, did change again. As we'll argument in the proposed paper, the introduction of the EU Framework Agreement on telework, a better attention to the wellness of workforce, and a "novel vague" of HR management who pays large attention to CSR' reputation of business, has created the condition, at least in some large firms, for a new attention in the use of telework as a tool for increasing the work life balance of employees.

II- The new regulatory framework

On the 9th June 2004 the Interconfederal National Collective Agreement was signed by the three trade union Confederations (CGIL, CISL, UIL), by Confindustria[1] and by other 19 entrepreneur organizations. This implements in Italy the text of the European Framework Agreement on telework adopted in July 2002. This agreement aims at defining the general national framework with reference also to telework, leaving ample space for collective and individual bargaining, though the latter must respect the minimum conditions for protection established by the text (Coletto, 2008).

The agreement highlights that telework is a means to modernize the organisation of work and that it may furnish a better work-life balance by giving the workers concerned greater autonomy.

[1] Confindustria is the General Confederation of Italian Industry.

The Italian agreement confirms the principles set out in the previous European Framework Agreement which are as follows:

- The free will of both the parts involved: the employer and the worker.
- The reversible nature of telework.
- Equality of treatment. Teleworkers enjoy the same rights as those who work on the employer's premises.
- Health and safety. The employer is responsible for the health and safety of the teleworker and must provide all information on company health and safety policies, especially as regards the use of visual display units.
- Work equipment. The employer is normally responsible for furnishing, installing and maintaining the equipment necessary for the telework.
- Privacy. The teleworker's privacy must be guaranteed.
- Autonomy. Within the limits established by the law, collective agreements and company regulations, teleworkers are responsible for the organisation of their working time.
- Training. Teleworkers must receive a specific training capable of providing them the necessary competences to use technical work equipment and the specific knowledge required to work in an organisation characterised by telework.
- Union rights. Teleworkers have the same union rights as their colleagues working in an office.
- Data protection. Both employers and teleworkers are responsible for the protection of the company data.

In conclusion, it is not an innovative agreement but the importance of those who have signed it (all the biggest union confederations and entrepreneur associations) and its European derivation guarantee an harmonious set of rules applicable all over Europe and create a good framework which will favour a second cycle of telework experiences (Visser and Martin, 2008).

III- Corporate Social Responsibility and new strategies of human resources management

The only social responsibility of business is to make profits (Friedman, 1970). With these words, in the Seventies, the Nobel Prize winner Milton Friedman described Corporate Social Responsibility. In his opinion, social obligation concerned the maximization of profits, respecting the rules of the open, correct and competitive market, in order to produce, in an efficient way, wealth for all, capitalists and workers.

What is our attitude toward this statement today? Market globalisation has made us understand that ethical principles and profits maximization are inseparable practices. In fact, interconnected economy has opened new perspectives and challenges for companies , but at the same time it has made their organization and their relations with the environment in which they operate more difficult. This phenomenon regards not only economics but it has had strong repercussions also in other sectors.

We must remember the growing importance of communication: the image and the reputation of a firm are fundamental factors to be competitive, because consumers and NGOs ask for more and more detailed information about the production of goods and services, and about the long term effects of development. The consequence of this growing attention is that economic analysts are not satisfied with normal financial statements, but ask for additional information about context and company positioning in the public opinion.

Companies, therefore, are not only called to adopt careful market behaviours, but are also called to be more responsible. A growing number of companies has adopted the concept of social responsibility, considering it an important economic value.

It is known that the performance of a company depends on a variety of intangible assets, like knowledge value[1], innovation ability, the consent and the confidence of the various categories of stakeholders, reputation and, last but not least, the ability to contribute to the wellness of the community.

Examples of innovative practices carried out by companies are those oriented to improve the quality of work, to create surer and more ergonomic workplaces, and to give equal opportunities to men and women.

In this context, we can insert the use of telework in companies: it is an innovation that both companies and workers consider a win-win. It improves work under the profile of work-life balance, as it creates a significant share of free time to employ in other activities, considerably improving, therefore, the family quality of life.

As for the benefits telework produces in society, it is enough to remember that:

the reduction of workers commuting back and forward from work reduces traffic pollution: if in Italy one million people could telework from home at least one day per week, the monoxide emissions in the atmosphere would be reduced by about 100 million of Kg/year;

telework can help economically the peripheral European regions, improving their labour market vitality, because it is possible to attract or maintain in these areas the most specialized workers.

Telework and work-life balance

Telework is a strategic tool thanks to which a firm can combine the company needs of economic performance and external visibility with those of its workers and of society as a whole. Telework allows a fairer balance between work time and free time, giving the possibility to carry out other activities and to improve one's overall quality of life. This appears even more relevant if we consider that at present people tend to be less and less satisfied with the free time they have at their disposal and that they consider it a scarce resource.

It is clear that telework is an answer to the company need to adopt ethical behaviours, a response to the pressure that society places on the productive systems so that the issues of economic and company development do not diverge from the interests of the people. Thus, the rediscovery of telework practices in many companies must be read as a request of a better work life balance by a workforce that sees women as the protagonists in many key services sectors.

IV- The case of Poste Italiane

Poste italiane Spa is the first postal service company in Italy (collecting and delivering letters, prints and parcels, telegrams, express currier and online services). At present, Poste Italiane employs over 150 thousand people and its annual turnover was 17.055,6 million Euros in 2006. The introduction of telework in Poste Italiane is inserted within a favourable contractual and company policy framework. With reference to the working contract, telework is regulated by the art. 30 of the CCNL2 signed on the 11th of July 2007 and which applies telework to non-managerial personnel; with reference to the company strategy, we can consider instead the Protocol on Corporate Social Responsibility signed on 31st of July 2007, in which the parts involved agree to promote technological and organisational innovative solutions capable of balancing both company and individual needs. In fact, within the Poste Italiane working contract telework is defined as a innovative way to work finalised to satisfy the organisational flexibility and productivity demands of the company conjugating them with the family and social life of the workers in relation to the environmental context as well as to the territorial conditions and the problems of mobility. The feasibility analysis carried out inside the company has allowed the individuation of some potential organisational potential contexts in which to introduce home-

[1] More and more often we talk about the concepts of "knowledge Society", knowledge management and knowledge economy to indicate the fundamental role of the processes of knowledge accumulation for the economic growth and the competitiveness of systems and companies. See: M. Castells, The Information Age: Economy, Society and Culture, Blackwell Publishing, Oxford, 1996- 2000, 3 vol.

[2] National Collective Work Agreement.

teleworking. The first sector where the experimentation has began for a period of 6 months is the Contact Center (CC) of Poste Italiane which manages services of mobile and phone telegram acceptance, and the working of off-line postal products. Ten employees have been chosen for the experimentation.

While this experimentation goes on, who writes this paper has been carrying out a sociological survey to monitor the progress of the project and to provide useful results for its continuation and the extension of telework to other company sectors. In particular, the aim of the survey is to investigate telework implications at organisational, relational and socio-psychological levels for the managers and the workers involved, focusing on the advantages from the work-life balance point of view. The data collection is carried out using different but complementary research tools. An informative form to collect preliminary information on the professional, social and personal profiles of the teleworkers is used, and in depth interviews are carried out to investigate on their professional and personal opinions about telework. An innovative aspect of the overall research iter is the will to integrate the data collection and the interviews with the filming of video-clips. The aim is to improve the survey contents using the typical tools of visual sociology, focusing on the emotional and expressive dimensions of the protagonists of the research (Grady, 1996).

V- The teleworkers' opinion

Work condition

The ten teleworkers involved in the experimentation have a full time open-end contract of six daily hours. The work time is distributed according to shift work system used by the two Contact Centers analysed: 24 hours a day in the CC of Rome and from 8.00 a.m. to 8.00 p.m. in the CC of Naples.

It is on average 21 years that the ten teleworkers have been working in Poste Italiane: from a minimum of 7 years to a maximum of 31 years. Among the interviewees there is a majority of women (8), while the men are only two. They are on average 48,5 years old (min 38 – max 57) and their level of education is medium.

Six teleworkers have children who live with them; in particular, four people have two children and two teleworkers have three children. The first child is 23 years old, the second one is 19 years old and, finally, the third one is 18 years old.

The home-work transfers

The interviewees travel on average 53,5 km to reach their work place, with a minimum of 7 km and a maximum of 90 km. It is important to stress that there are four people which travel about 90 km.

The majority of the teleworkers (7 out of 10) use the train to go to work, two workers always use their own car and, finally, one teleworker uses both car and train because her journey is divided in two parts. The first part, of about 25 km, is made by car. This way, she can reach the railway station where she takes the train to get to the office. The second part of the journey, therefore, is made by train and another 65 km are travelled.

The three workers who use their own car go to work consuming an average of 7 litres of fuel every day.

As to the time they take, the interviewees spend on average 1 hour and 26 minutes (minimum 45 minutes, maximum 2 hours). Thus if we calculate the round trip the interviewees, thanks to telework save an average of 2 hours and 56 minutes a day; time they can invest in other activities.

To this we can add also some money saving: at the moment the teleworkers spend on average 133 Euros for their home-work transfers (minimum 25 Euros – maximum 300 Euros).

Perceptions and opinions on telework

The interviews realised with the teleworkers have returned a frame of their perceptions and opinions on telework, highlighting expectations on the possible implications of the new experience both at personal and professional levels.

Analysing the text of the interviews, what emerges immediately is that the decision to ask to telework has been a "choice", a "decision" evaluated and taken consciously. Moreover, for many of the interviewees it is an opportunity they have finally obtained after wishing it for a long time.

"I didn't think about it at all", it has been an instinctive thing, something clear and convinced"

Or

"it has been a positive thing considering our situation of uneasiness"

Finally

"when I saw the notice in the company showcase I couldn't believe it, because I wished that sooner or later also Poste Italiane would have started using telework"

In this sense, the motivations behind the choice to telework regard mainly the need to solve logistic problems related to daily home-work transfers. "Journey", "to travel", "traffic", "distance" are recurrent words in the interviewees' speeches, which are always connected to a set of expressions that evoke the idea of deep uneasiness for the difficulty to respect the work time, for the "delays", for the continues races to catch trains and other public transport, for the "breathlessness" and the "stress" which derive from all this.

"The quality of quality, the time wasted going to work. Four hours of life that you waste travelling by car"

The interviewees live the possibility of telework as a big opportunity from which they attend important advantages. The demands they hope to satisfy are mainly related to family problems, like having more time to follow the family and manage the home.

"As well as to work, I give importance also to the family. This is the main motivation"

The expectations about home teleworking

The predominant perception is that telework will not modify the work contents but instead it will have a positive impact on the level of concentration and on the tranquillity of the working environment. The teleworkers declare that the absence of the distractions typical of shared work places will make their work activity more fluid and continuous.

"From a quantitative point of view, I think that at home it is possible to work more, even if it depends also on us, it is important fort a person to be responsible"

Or

"I believe that you produce more thanks to the stress that you don't accumulate during the journey. You stay at home and you are relaxed, you begin to work with a different spirit, you have an energy that you did not spend in the traffic or to find parking. Less stress, more productivity".

At the same time, the expected advantages regard mainly the possibility to eliminate the "dead times" of home-work transfers. Thus, the time "saved" becomes a resource to invest in various private life dimensions: social relationships, hobbies, rest, etc. Life becomes easier and the ability to plan time increases with important implications also on one's "personal accomplishments".

"I will do something for myself and to something more for my children"

Finally, the insistence on the positive consequences of telework is also highlighted by the difficulty with which the interviewees indicate disadvantages and eventual problems of working at distance.

"At the moment I don't see disadvantages, for me in this situation there are only advantages, because I can work calmly at home, improving also my quality of life"

In fact, the majority of the teleworkers do not see problems and only some of them indicate the possible sense of isolation connected to being alone at home during work.

"a disadvantage could be not to see your colleagues, but with regards to this, I don't have impediments, because I have a good relationships with all and thus there aren't problems"

VI- The managers' point of view

To catch the managers' point of view, we have interviewed the directors of the two CC involved in the experimentation and the four tutors chosen as direct references for the teleworkers.

The managers perceive the telework project as a great opportunity both for the company and the workers.

"I have always considered telework as an alternative for the workers that move a lot to come to the work place; I have always thought that work could move to the worker's home"

This experimentation represents one of the main signals of the will of Poste Italiane to begin an important process of change and innovation. In fact the interviewed talk about a company mentality, a different organisational culture in Poste Italiane, which makes it capable of experimenting alternative processes and ways of working, focusing on the wellness of its personnel.

"In this moment Poste Italiane obtains three advantages but it is mostly thinking about the worker, about the uneasiness of the workers"

Or

"a company like Poste Italiane that has always showed an interest towards the worker's demands, cannot but make a choice in this sense"

The advantages and disadvantages of telework

It is known that telework can have a positive impact at social, organisational and individual levels. Thus, it is not surprising that the managers have positive expectations and perceptions about the advantages of telework for the various workers involved.

From a social point of view, the interviewees understand that if telework was extended and involved a great number of workers also in different companies, this could have a positive impact on the environment, contributing to the reduction of traffic and consequently of pollution.

With reference to the companies, telework can answer in a functional way to various organisational necessities: from cost reduction, to the lessening of absenteeism, to the improvement of work productivity standards.

Finally, from a personal point of view, the advantages that teleworkers can obtain working at home, are evident. The main advantage is certainly the possibility to balance better company and private live demands. Especially for people who make a long and exhausting journey to go to their working place.

VII-Conclusion

Considering that starting from the '90s of the past century, the spreading of telework has followed a wavering iter, alternating moments of high level of interest by the companies and the Italian legislation, and moments of little attention, is it possible to assert that at present telework has become central within company strategies? At the same time, are the motivations and the aims that the companies want to obtain using telework the same which characterised the previous projects or is it possible to identify new options for the introduction of telework in the strategies and action lines of companies?

As already pointed out in this paper, at present Italian companies are showing a new interest for telework and for the opportunities given by a work practice that, with reference to its level of

penetration, can still not be considered innovative. The explanation of this trend is related to the development of two phenomena. On one side, it is possible to consider the presence of a clearer normative and contractual framework which, after the adoption of the European Framework Agreement on telework in Italy in 2002, gives the general indications in which to insert and regulate telework, nevertheless leaving much freedom to company dealing. Within this framework, it is possible to define the conditions and the regulatory principles set according to specific organisational demands. On the other side, the attention given by companies to Corporate Social Responsibility policies allows us to show telework under a new light, where human resources management strategies aim at improving the wellness of the personnel also with reference to their work-life balance. In this perspective, the minimalist conception typical of the telework experiences developed in the last century, which were characterized by an experimental nature, is abandoned in favour of a new approach that inserts telework within wider human resources management policies. In this sense, telework has become a management tool where human resources management is not considered as an adaptive process, but as an operative system able to create a real balance between business strategies, organisational structures and the cultural, technological, environmental and social specificities predominant in the context where the organisation operates and is inserted. The present transformation of the work force, characterised by new values (autonomy, personal growth, satisfaction etc.), culture, expectations and demands (flexibility, work time and life balance) (Huws, 2006), needs to develop innovative procedures of personnel management capable of improving the quality of life and the conditions of the workers, contributing to the wellness of the entire organization. And this wellness can be reached only through shared decisional processes capable of considering the requests of the workers. On one side this favours worker engagement and sense of responsibility; on the other side, it produces positive effects on the productivity and the competitiveness of the organisation.

The telework project of Poste Italiane, presented in this paper, represents a concrete example of the trends here described. In fact, the company will is to consider telework as an extensive tool of human resources management and not just as a practice to introduce in a restricted way in order to satisfy specific necessities of sectors and/or persons with specific and marginal problems. Since the first company agreement, which regulates telework within the Contact Center sector, studies and discussions have followed to develop other company agreements regulating telework in sectors and with reference to professional profiles different from those of the Contact Center employees. Consequently, if Poste Italiane tries to extend telework to a higher number of employees, it will be able to connect its human resources management culture and policies to the principle of organisational wellness, obtaining important results in terms of efficiency, efficacy and productivity. It is known that company performance depends on different intangible aspects such as the improvement of knowledge, the capacity to innovate and create, the consent and the confidence of the various categories of stakeholders, the reputation and the capacity to contribute to the wellness of workers and to that of the people as a whole (Di Nicola, 2005). In conclusion, the success of a telework project, measurable in terms of the advantages for the workers, the company and society, creates a virtuous cycle between the competitiveness of a company and the improvement of its image and reputation.

References

Bergum S. (2007) What has happened to telework? Failure, Diffusion or Modification?. The Journal of E-working, February.

Castells M. (1996-2000) The Information Age: Economy, Society and Culture. Vol. 1-3, Blackwell Publishers Ltd, Oxford.

Coletto D. (2008) Telework in Italy, Eironline, European Industrial Relations Observatory On-line, http://www.eurofound.europa.eu/eiro/2007/12/articles/it0712049i.htm.

Di Nicola P. (2005) The Point on Corporate Social Responsibility. MediaZone, 16 January, http://www.mediazone.info/site/it-IT/.

Di Nicola P., Della Ratta F., Como E., Rosati S. (2003) Inhibitors Analysis. Regional Report, eGap, European Project, IST-2001-35179, www.egap-eu.com.

Di Nicola P., Russo P., Curti A. (1998) Telework between Law and Contract. Ediesse Rome, 1998.

Faccioli P., Losacco G. (2003) Handbook of Visual Sociology. Franco Angeli, Milan.

Grady J. (1996) The Scope of Visual Sociology. “Visual Sociology”, vol. 11, n. 2: 23-38.

Huws U. (2006), (edit by) The transformation of work in a global knowledge economy: towards a conceptual framework. WORKS project, Katholieke Universiteit Leuven, Leuven.

Istat (2000) Culture, sociality and free time. Year 1999. Rome.

Losacco G., Doing Sociological Films: A proposal, “Visual Sociology”, vol. 11, n. 2: 83-86, 1996.

M. Friedman (1970) The Social Responsibility of Business is Increase it Profits. Time Magazine, New York, 13 September.

Visser J., Martin N. R. (2008) Expert Report on the Implementation of the Social Partner’s Framework Agreement on Telework. Amsterdam, January, http://www.uva-aias.net.

A Toolset to Support the Early Stage of Innovation

H. Duin[1], A. Geven[2], S. Dittenberger[2], M. Tscheligi[2], A Hesmer[1,*], K.-D. Thoben[1]

[1] BIBA GmbH, Bremen, Germany

[2] CURE – Center for Usability Research and Engineering, Vienna, Austria

* Corresponding author: hes@biba.uni-bremen.de; +49 421 2185532

Abstract: This paper aims to present the achievements of the European funded project Laboranova in terms of supporting ideation processes by means of an internetbased tools set. The tools developed address the phases ideation, evaluation and connection (between people and information). The aim of the tools and the interoperability is shown within a scenario.

Keywords: Innovation; Scenario; Ideation; Innovation Software

I- Introduction

Nowadays a boom in innovation is taking place in society. Innovation is said to be the key to future grow in Europe. Innovation is key to the advantage of European economy against its competitors from today's successful economies and the emerging competitors from Asia and other emerging countries. In order to achieve continuous strategic innovation and thus create persistent competitive advantage, European organizations need to increase their capacity for carrying out open-ended and nonlinear problem solving involving a wide participation of people in knowledge-rich environments. Companies are well aware of this issue and have implemented strong innovation processes which are often represented by the stage-gate model. Common to nearly all of these innovation processes is the black box in the beginning of the process called idea generation.

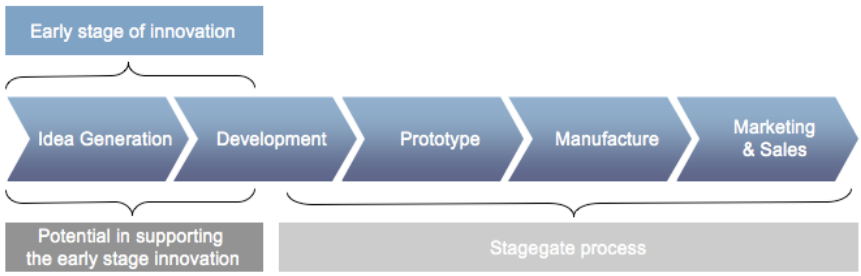


Figure 20: Innovation Process (Rothwell 1990)

Referring to R. Bauer 85% of product development time is invested in products which never reach the market (Bauer 2005). Furthermore only 18% of the innovations brought into the market prove sustainably successful (Innovation Network 2005). The figures show the high potential in increasing effectivity and efficiency with innovation development. Wolfgang Jonas (Bauer 2006) claims that today's efforts heading for the development of planning practices and methodological approaches without having the pretence of planning everything completely. This is consistent with Akin's theory that states that "no quantifiable model is complex enough to represent the real-life complexities of the design process" (Akin 1979). In relation to information technology (IT) support Rahe (Klünder 2006) states that the problem with the most planning instruments is the inattention on the fact that during a development process new knowledge is

achieved that changes the project. This underlines the thesis of non-linearity in the early-stage-innovation. The user centric approach is becoming more and more important to organizations.

Therefore we believe in enhancing the fuzzy-front-end of innovation by providing an IT tool set to support innovators in order to make the early-stage innovation more effective and efficient. The handling of and work with ideas is quite fuzzy and unstructured in this phase. Thinking of the idea to be the first step to a successful innovation it is necessary to enhance the input quality to the subsequent steps of innovation processes. Therefore the innovators work within ideation needs to be externalised and supported.

The European funded project Laboranova develops an online tool set to support the real needs of non co-located innovators in companies or in between communities within the idea generation and development in the early-stage innovation (ideation, cp. Vaghefi 1998) in non-linear processes. In effect, tools are developed to augment the individual's and the organization's capacities with respect to innovation in three domains:

- selection of (potential) collaborators within the community ('connection')
- knowledge representation in innovation processes and idea development ('ideation'), and
- decision making on the right resources for the right ideas ('evaluation').

This paper describes a set of tools for supporting the early stage innovation process. The tools are described by means of a scenario, which gives a detailed narrative account on the potential implementation of the tools in a real setting.

II- Scenario

Scenarios can be seen as a communication support tool for complex developments that have to be explained to various target groups. As a railway track guides a train from station to station, a scenario guides the audience through elements in a complex landscape. By providing a concrete example of a system's implementation instead of only an abstraction of it, people can more easily understand where it is and could be implemented in other, comparable settings. They make it easier for people to understand what, why and how specific design decisions have been taken. By "telling a story", the scenario connects loose ends (one-way communication) and makes it easier for the listener to ask questions about specific points. It helps communicate open questions with regards to implementation issues that might be different in specific situations that the audience finds themselves in and provokes questions (two-way communication). Scenarios are not just about telling stories; they are a tool in a toolset for communicating about complex systems. The narrator, both orally and written, can stop longer at stations along the railway track that are more relevant for the specific audience, or pass them quickly when they are not, thus shaping the scenario to the demands of the specific audience.

The audience for a scenario is a broad one. Potential end-users are an obvious target where scenarios can be used to guide users through the jungle of a complex piece of software, bringing it down to earth and explain it by example. Other audiences can be e.g. team members that have to work together on a large distributed team and have to find a common denominator with which they can identify and develop for. A scenario in this case can integrate such elements as personas, use cases, and so on. Caroll (1995) describes a set of eight goals where scenarios are and can be used effectively with various audiences: (i) story development of current use practice for requirements analysis, (ii) a way to communicate between users and designers, (iii) provide examples to motivate design rationale, (iv) help people outside the development team envision the goals, (v) support for software design, (vi) implementation, (vii) ease training of users of the product, and (viii) provide example-based documentation. In each

of these settings, the scenarios provide the advantage that everyone involved has a better picture of how the tools can be used.

III- Laboranova Scenario and Toolset

The Laboranova project uses a scenario to describe the overall idea, the tools and the interaction between the tools as a way of internal and external communication. The scenario assures a common understanding of all partners and allows the consortium to present the outcome of the project in an understandable way for an audience.

The Toolset

Early-stage innovation processes aren't linear but fuzzy without defined details or goals. Iterations of problem, solution and possibilities are characteristic of the workflows of ideation processes and are due to the generation of new knowledge throughout the process (Simon 1973).

Existing tools such as Collaborative Working Environments (CWEs) (Hribernik 2007a/b) mainly focus on supporting the traditional working paradigms of linear workflows by providing IT-based platforms for planning, scheduling and carrying out tasks (NovaNet 2006). These tools represent individual methods related to idea generation or support innovation processes on a management level. The usage of such proprietary tools in economies practise is very seldom (NovaNet 2006).

In order to achieve continuous strategic innovation and thus to sustain competitive advantage, organizations need to increase their capacity for carrying out open-ended and nonlinear problem solving involving the broad participation of people in knowledge-rich environments. This must be supported by tools dealing with the early-stage innovations, which require new paradigms for managing the knowledge transfer, the social dynamics, and the decision processes involved.

The development of successful tools needs to focus on real requirements in distributed working environments of innovators in ideation processes. Chapter I- describes the three domains of the early-stage of innovation: ideation, connection and evaluation. The development of tools to support innovation workers took place in context of these domains (Figure 21: The Tool Set and its Domains). The front end to the user offers a single sign on functionality for all tools of the set. The homepage or Mash-Up is the entry point for the user. Depending on the current need the user chooses one of the tools fulfilling his need. There might be more than one tool available for the same purpose.

The interoperability of the tools assures the idea repository; a database is accessed by all tools. The idea repository contains the representation of ideas to be worked with within the tools. Multimedia representation e.g. by text, pictures and videos is used to describe an idea in the idea repository.

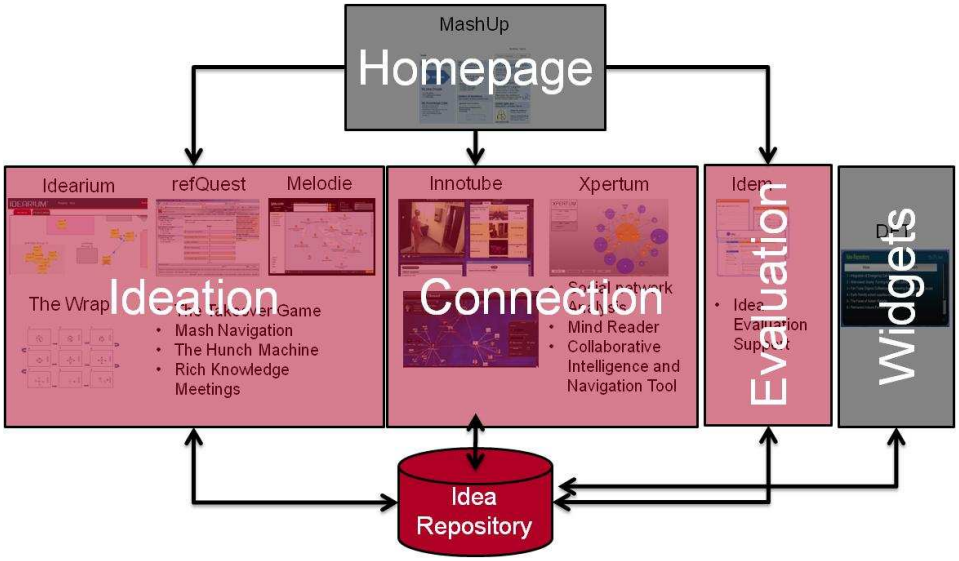


Figure 21: The Tool Set and its Domains

The tools are described within the scenario in the "tool section". It needs to be mentioned that not all functionalities of the tools are addressed within the scenario. A couple of tools (e.g. InnoTube) provide functionalities in more than one domain of the early-stage of innovation.

The Scenario

It was mentioned earlier that Laboranova addresses the real needs of innovators within the early-stage innovation and supports non-linear processes. As the scenario presented reduces the complexity of the early-stage innovation the approach states a linear process as an example.

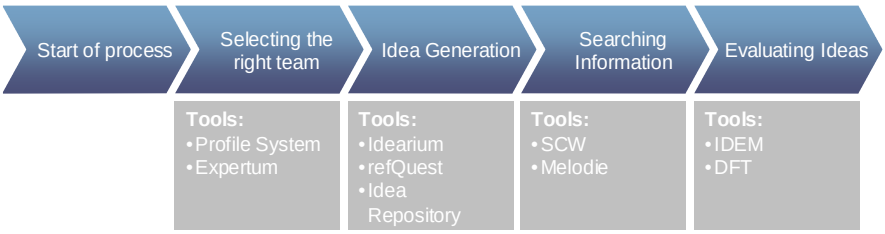


Figure 22: Early Stage Innovation Process of the Laboranova Scenario

1) Start of Process

Story

Elena Bergsen, manager of a toy shop, is responsible for store operations and band management. As the shop is running out of customers Elena decides to enhance the shopping experience by a redesign of her store. She is going to to work, together with a team, on new concepts for enhancing the buying experience in the shop, as well as on possible new products. Elena doesn't know potential experts in the fields she needs for the redesign but she knows she will find some on the online based innovation support tool set Laboranova within the toyshop company. Elena enters the Laboranova MashUp as an entry point to all supportive tools within the tool set.

2) Selecting the Right Team

Story

First thing Elena has to do is finding the right people for the project. She needs a specialist in "User experience design", a marketing person and an International Business Developer. Elena enters "user experience" as a search in the Laboranova **Profile System** and finds some people within the organization that have entered it as one of their interests. The search results contain a list of profiles, including:

- Byron Nakaso, User experience design, interaction design, visual design, creative direction, information architecture, prototyping, user research

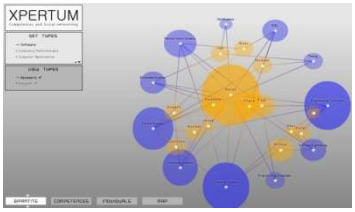
- Walter Clark, Product Definition, User Research, User Experience, Software and Internet Design, Consulting. International Experience

A second search for the keyword 'shop' returns additional people:

- Muthu Merrifield, Merchandise & Inventory Management, Supply Chain Management, Replenishment, Store Operations

- Inga Latham, Product development strategy & implementation, user experience strategy & implementation, usability consultancy, shopping comparison, travel systems, content management, copywriting & journalism

She is doing the same to find people who fulfill her requirements in the other areas as well. Elena maps the potential team members to **Xpertum** and is now able to see a visualization of the relationship between the individuals and the different competences of the team members. The visualization provided by **Xpertum** offers the Team leader a good overview of the competencies which are covered by the people he has invited to the team.



Tools

The **Profile System** shows the importance of recording people's interests and expertise both from them and from their interaction with the system. This is rich profiling of individuals involved in innovation processes.

Xpertum is an interactive web-based tool for visualizing social networks which uses basically force-directed and bipartite graph algorithms. People can visualize data and relationships between two entities - competences and individuals - through different views in order to analyze important aspects in the current social network. To facilitate the integration with other tools, an xml data file is required as parameter to proceed with the visualization. The visualization of relationships between entities help to graphically see the significance related to competences and individuals. Differentiations in colour, size and shape are used to emphasize the relationships between entities.

3) Idea Generation

Story

The team uses **Idearium** to start a shared brainstorming session, by adding post-its to a virtual wall, which can be grouped and moved there. Also, ideas can be commented and discussions can be attached to them, **Idearium** allows also to define relationships between ideas. The session created ideas concerning the integration of marketing and business ideas, like ecological toys from the travel scenario, look at the buyer instead of the user or customization

for your toys. Afterwards Elena uses the **Idea Repository** to group the collected ideas in **Idearium**.

According to their newly collected ideas they discuss how to proceed and decide to split the ideas to the general interest of each person and produce a short video about each idea. Bryon, as the team‘s specialist for user experience design and creative direction, states that he wants to work on the ‚Clothing Factory‘, as well as on the ‚Christmas Factory’, ‚Underwater Kingdom’ and ‚Chocolate Factory’ idea. Bernardo, as the team‘s specialist for merchandising and marketing, is interested to work on the idea of the ‚Underwater Kingdom’, the selling of audio products and the ‚Fairy Tale Land’ idea.

They try the **refQuest** game on their idea of the underwater kingdom first. The group thinks that it might not make it. A gaming scenario is prepared by the team leader and she organizes a workshop to commonly play the game. The players are running iteratively through the steps of idea generation, idea presentation, idea rating, idea refinement, sometimes interrupted by some events set by a facilitator to reframe the ideas and/or bringing in new thoughts. At the end of the workshop four further ideas are selected to be saved into the **Idea Repository**.

Tools

Idearium is a visual and interactive tool for asynchronous and distributed brainstorming which enhances the ideation process with the aid of agents. People can create projects and invite other users to participate in the brainstorming. To facilitate the selection of peers, user competences are publicly available on their profiles. Brainstorming sessions can occur synchronously with multiple users simultaneously or asynchronously. They are presented in a whiteboard where users can publish their ideas (as Post-its on the board), comment existing ideas or start discussions over them

refQuest with its gaming approach allows the collaborative generation of ideas in locally dispersed teams. It structures the process of idea generation and it allows the incorporation of creativity methods; thus it is more than a distributed brainstorming tool. Users (players) are observed by a facilitator, who has the option to steer the ideation process.

The **Idea Repository** is the central integration component of the toolset. Each tool has access to the repository to store or to retrieve ideas and connected information like comments, ratings, associated documents, etc.

4) Searching Information

Story

Each of the team members search the web individually for information related to the identified themes using the **Social Collaborative Web Search Tool**. The benefit of this tool presents itself through allowing the whole team to share specific queries and search results with other team members, as well as to comment on the gathered ideas. They generated the idea of a ‘Christmas Factory’.

Then, the team uses **Melodie** to add photos, papers, interviews and many other things, which had been collected during the information gathering process. The team leader uses **Melodie** further for the filtering, grouping and adding of collected information; so he is able to set up tasks and incite a discussion among all team members how to proceed. They develop further additional thoughts related to store design. Additionally to their already existing idea of the Christmas factory, they add the idea that the store could be designed around a narrative, such as an underwater kingdom.

Elena starts up **Melodie** in order to visualize their ideas displayed as a map. The semantic system of **Melodie** allows all common information to be liked, as well as the project progress report enables users to inform them about the status of achievement.

Tools

The **Social Collaborative Web Search** allows the whole team to share specific queries and search results with other team members, as well as to comment on the gathered ideas.

Melodie is based on the concept of an idea box. All ideas are shown as a cartography which gives all results visualized. There is a semantic system which links all same topics between them, as we can better assimilate results. Moreover, people can improve idea by entering ideas of innovation. All ideas have a listing and people allowed to access to Melodie are permitted to modify until the idea is finalized.

5) Evaluate Ideas

Story

Elena creates a new idea market in **IDEM** containing a few 'good' ideas among which a subset will be selected for further development. She invites evaluators (traders) from several regional groups to participate in the new idea market. Traders review the ideas in the market and buy idea stocks when they see a potential for success or sell when they identify potentially not successful ideas. Using the idea-blog functionality of **IDEM**, traders propose enhancements to the ideas in the market. Upon market she has a ranked list of ideas that helps in her final decision and a set of idea-enhancements that help her to further develop the ideas.

Curiously, the team members watch the idea ranking process by external evaluators at the market place during the **IDEM** process. They had been working in different groups on the development of the latest ideas and are keen to get to know how the evaluators estimate the success of their ideas. The team members periodically view detailed feedback on the ideas under evaluation by using some desktop widgets of the **Distribute Feedback Tool**.

They immediately see that the most of the ideas for the 'Christmas Factory' are not being evaluated favourably so they arrange to have another brainstorming session in **Melodie**

Tools

In **IDEM**, people can put their ideas on internal prediction markets (PMs) and thereby explore and participate in a collaborative evaluation process. The participants can bet on the future success of ideas using virtual stocks representing future events whose price is a function of transactions representing individual probability-estimates of the event happening. The result is a prediction market that aggregates knowledge from many individuals in order to involve a broad base of insight in the evaluation of new ideas and concepts. Users are motivated by winning, teams are encouraged to transfer knowledge and organizations profit from a collaborative evaluation harnessing the "wisdom of crowds"

The **Distributed Feedback Tool** consists of a set of widgets allowing the user to perform some basic and simple interactions with the repository and/or specific tools according to user role. The feedback is customisable and includes e.g. widgets for entering or commenting an idea, monitoring and listing of all or selected ideas, getting notifications on changes, etc.

IV- Summary and Outlook

The Laboranova project aims at the support of innovators within the early stage of innovation. As todays and futures work takes place dislocated and in many cases in an open manner (cp. Cross 1984) the tool set is internet based and takes advantage of multiple media (e.g. audio, video, pictures and text). All tools use a common and continuous data structure to assure the data consistency in between the steps of the idea generation and development.

The scenario presented does not fit with the complexity of work within the early-stage innovation. It is an approach to understand the basics of Laboranovas outcome. As the project develops far more tools than described in this paper the scenario needs to be enhanced based on the knowledge achieved and the tools developed in Laboranova.

A more complex and comprehensive scenario will be developed within the project's period. This advanced scenario will provide an all-embracing overview on the Laboranova tool set and present the integrity of this.

Some tools have been used already in field trials in the automotive, IT development or public sector. The acceptance of usage of the tools, the outcome and the value for workprocesses in the early-stage of innovation is high. Still there are tools developed which need to prove their added value to ideation processes in trials.

Acknowledgement

This work is part of the project Laboranova and has been partly funded by the European Commission under contract IST-FP6-035262. We would like to thank all partners of the Laboranova consortium and the European Commission for support.

References

Bauer, R. 2005: Kein Bedarf für Plastikräder, (Freitag 43)

Carroll 1995: Carroll, J.M. (Ed.). Scenario-Based Design: Envisioning Work and Technology in System Development, New York: Wiley, 1995

Cross 1984: N. Cross, Developments in Design Methodology (John Wiley & Sons, Chichester, 1984)

Innovation Network Austria Study, 2005

Rothwell 1990: R. Rothwell, Successful industrial innovation: critical factors for the 1990s, R&D Management 22 (3), 221–240 (1992).

Vaghefi 1998: M.R., Vaghefi, and A.B. Huellmantel, Strategic Management for the XX Century (Boca Ranton, 1998)

Hribernik, K., Thoben, K.-D., Nilsson, M. (2007a): Technological Challenges to the Research and Development of Collaborative Working Environments. in: Encyclopedia of E-Collaboration. Idea Group Reference,

Hribernik, K., Thoben, K.-D., Nilsson, M. (2007b): Collaborative Working Environments. in: Encyclopedia of E-Collaboration. Idea Group Reference,

Simon, H. (1973): The Structure of Ill-structured Problems, originally published in Artificial Tony J. Watson. Rhetoric, Discourse and Argument in Organizational Sense Making: a Reflexive Tale. Organizational Studies, 16(5):805–821

Bauer, B.(2006), Design & Methoden, (Design Report 11/06)

Akin (1979), An exploration of the design process, Design Methods and Theories

Klünder, P. (2006), Planbarer Brückenschlag, (Design Report 11/06)

Investigating co-innovation in exploratory partnerships: An analytical framework based on design theory

A.O. Kazakci[1,*], T. Gillier[2], G. Piat[3]

[1] Ecole des Mines de Paris, Paris, France

[2] EDF R&D – MINATEC IDEAs Laboratory®, Grenoble, France

[3] EDF R&D, ICAME Departement

* akin.kazakci@ensmp.fr, +33(0)1 4051 9208

Abstract: Intensive innovation contexts push organizations to search for new partnerships in order to explore value creation opportunities and to access external resources. Recent literature shows that more and more partnerships are established before the object and the terms of the partnership has been determined. In such exploratory partnerships (Segrestin 2006), motivated by the prospect of joint value creation and co-innovation, partners explore and progressively construct a common project and an agreement on the sharing of tasks and outputs. In this work we investigate co-innovation dynamics of exploratory partnerships within the context of MINATEC IDEAs Laboratory® (MIL). MIL comprises several industrial partners from different sectors and a major scientific partner specialized in micro-nanotechnologies. Partners of MIL share resources to explore new project ideas and co-innovation opportunities. A particularity of MIL is that all its industrial partners come from different business sectors. The diversity of agendas, competencies and design strategies exhibited at MIL allow the examination of different dimensions of exploratory partnerships: Are there different configurations of exploratory partnerships? What are the dynamics of exploration? How does the exploratory process converge? An analytical framework based on CK design theory is used in order to examine the dynamics of exploratory partnerships within MIL.

Keywords: co-innovation, exploratory partnership, design theory, design oriented organizations, collective action

I- Introduction: MINATEC IDEAs Laboratory® as a distinguished context to study exploratory partnerships

1) Exploratory partnerships: exploring projects and synergies for co-innovation

Intensive innovation contexts push organizations to a constant adaptation process. The need for adaptation motivates organizations to establish new partnerships in order to explore value creation opportunities, to create new capabilities and to access external resources and competencies. This search for fruitful partnerships has been accompanied by a shift in the nature of partnership relations. Aside from the traditional supplier/customer type relationships, new forms of relations are sought after by the companies in the more upstream level where the outcome may have direct impact on the strategic level (Maniak and Midler 2008). Segrestin (2005; 2006) named such upstream partnerships as *exploratory partnerships*.

2) MINATEC IDEAs Laboratory®: a platform for exploring innovation opportunities

The proposed paper analyzes exploratory partnerships within the context of MIL. The organizational structure of MIL comprises several industrial partners from a large scope of businesses and a major scientific partner specialized in micro-nanotechnologies. Partners are continuously exploring collaboration opportunities in order to build new innovative projects and to acquire new competencies. Quite typically for the exploratory partnerships, the object of the collaboration should be built while the distribution of responsibilities and outputs should be agreed. However, by contrast to bi(or tri)polar exploratory partnerships reported in the literature (Doz 1996; Powell, Koput et al. 1996; Segrestin 2005; Segrestin 2006; Birkinshaw, Bessant et al. 2007), the increased number of partners and their business' diversity induces additional difficulties and a variety of dynamics through out the exploratory phase. The diversity of agendas, competencies and design strategies exhibited at MIL offers a rich context for the examination of different dimensions of exploratory partnerships: Are there different

configurations of exploratory partnerships? How can cohesion be achieved when a huge number of partners are present? What are the basic mechanisms of co-exploration?

3) Analyzing exploratory partnerships: a framework based on CK design theory

The present work investigates these issues by considering the design process as the primary source for innovation. Adopting the view proposed by (Le Masson, Weil et al. 2006), the dynamics of collective innovation efforts within MIL are analyzed based on the observed design reasoning processes of the partners. In order to capture significant aspects of the reasoning processes and their interaction, the set of notions proposed by concept-knowledge (CK) theory of design reasoning (Hatchuel and Weil 2003; Hatchuel and Weil 2007) are used. CK theory describes design process based on the interaction and evolution of available knowledge and innovative (product or service) concepts. An analysis of some projects within MIL and the modelling of design reasoning of the involved partners, let appear that different start configurations are possible for exploratory partnerships. A typology of exploratory partnerships is derived thereof based on *the distances between concepts and knowledge of the partners.* The exploratory partnerships that take place within MIL are identified as distant concepts and distant knowledge partnership. Our observations posit that *any successful exploration process starts by approaching or connecting either the concepts or the knowledge of the partners*.

The plan of the paper is as follows: In section II, we present our methodology and the theoretical framework that CK theory provides. Section III presents an overview of MIL that we identify as a platform for exploring exploratory partnerships. In section IV, we proceed to a detailed analysis of these exploratory processes. Two example projects from MIL are used to illustrate the proposed analysis. Section V discusses the results.

II- Methodology and theoretical framework

The present research follows an active participatory research approach. The findings reported here are the result of an in-depth empirical case-study investigation (Yin 1990) and participation coupled by an abstraction and theoretical modelling effort. During 15 months, two of the authors continuously observed how design teams (engineers, marketing specialists, sociologists, managers…) operate within inter-firm collaboration context that MIL provides. Beside observation and empirical data gathering, authors participated actively to operational projects (new technology-based projects and user centred design studies) and to managerial meetings (one meeting per month) taking place at MIL.

Several research paradigms similar to our approach are proposed in the literature for collective action and management research (see e.g. clinical field research (Schein 1987), grounded theory (Glaser and Strauss 1967; Strauss and Corbin 1990), intervention research (David 2001)). Among these approaches, ours would be closest to Intervention Research since, beside constant observation and interaction with the field, our team played active roles in organizational processes by participating to projects. This methodology allows understanding on-going organizational processes and problems from an insider point of view which in turn allows adapting the way the researcher interact with the field and adjust its investigation when trying to make sense of the field (David 2001; Hatchuel 2001).

During our intervention, data have been collected in several ways. Beside everyday participation to and observation of internal processes, interviews with the actors and analysis of internal documents (partnerships agreements, meeting documentations…) have been done. Empirical analysis and the ideas provided in the paper have been presented at MIL during several seminars (to operational members, steering committee and to experts) and have been progressively enriched and validated with their feedback and contribution. Reactions were fruitful, and discussions indicated that the proposed model was perceived to be realistic and actionable through operational project and methodologies.

In our presentation, although we will not be strictly bound to any particular project, we will make use of two projects to ground the discussion and to illustrate some of the ideas. Unfortunately,

confidentiality issues will prevent us to give the exact information regarding some of the aspects of the projects and limit the level of detail during the presentation. These two projects will be referred to as "energy project" and "micro-fluidic project". "Energy project" aims to co-design valuable concepts related to new systems of power management and power supplies. It has lasted one year and lead to various original concepts, some of them were proved by mocks-up and user-studies. Regarding "micro-fluidic project", objectives were to learn about a new micro-technology and to envisage opportunities in partners' business. Today, a mock-up is achieved and possibilities of patents are strongly evaluated. Although they have different duration, they are highly representative of exploratory projects conducted at MIL. Furthermore, both projects are examples of common projects at MIL and thus are suitable for analysing how “emerging” projects become “common”.

An analytical framework based on CK design theory

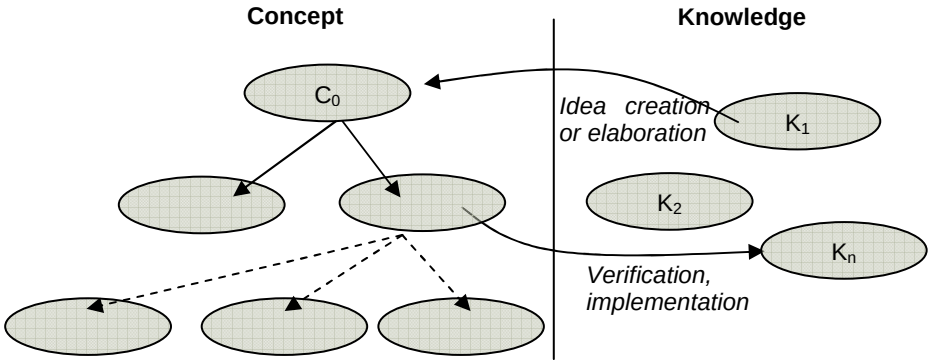


Fig1. CK design formalism

Our everyday participation and observation at MIL should ultimately yield to a theoretical understanding of its dynamics. To this end, our empirical investigation needs to be coupled by theoretical analysis. Since the primary objective at MIL is to design innovative products (using new technologies), we will use a theory of design reasoning to interpret our observations. In fact, design is the essential activity within MIL. For each partner, the unit representing that partner within MIL can be seen as a small design-oriented organization (Hatchuel and Weil 1999). Each such unit strive for creating new (product or service) concepts relevant to their own strategy and core business. Each such concept is both a final result *in fine*, but also, the process by which they are created provides the corresponding units a mean to leverage new and untapped knowledge.

Underlying the idea of design-oriented organizations are recent advances from design theory. (Hatchuel and Weil 1999; Hatchuel and Weil 2002; Hatchuel and Weil 2003; Hatchuel and Weil 2007) propose CK theory of design – a theory of design reasoning based on the interplay between two different spaces – a space C of concepts and a space K of knowledge; Fig1. Knowledge space models all that is known by a designer (or, a group of designer). This may include knowledge about objects and services, users’ preference, competences of the firm, laws, norms and regulations, etc. In terms of the theory, knowledge space contains all the propositions the designer is capable of declaring as true or false. Concept space, on the other hand, contains *new* ideas (the novelty of an idea is relative to a given knowledge space of a particular designer). According to the theory, such propositions do not have a logical status when a design process starts. The designer cannot say whether such thing may be possible, nor can he say that this would never be the case.

Design starts with a concept that can progressively be built and detailed by partitioning (i.e. by adding new properties) using available knowledge. The structure obtained this way is a tree spanning from the initial concept; the paths of the concept tree are called design paths. Design paths correspond to object definitions. When a new and unprecedented property is introduced

into the tree (by partitioning), a new definition is created – which might or might not lead to innovation. Such operations are called (conceptual) expansions or expansive partitioning. The new concepts that appear this way should be investigated, built and validated in the knowledge space. Often, this requires acquiring new knowledge - the expansion of the knowledge space. Design process can then be described by the interaction of two spaces: knowledge is used to further elaborate the product descriptions in concept space, while concepts are used to reorganize and expand the knowledge space.

III- MINATEC IDEAs Laboratory® : A suitable platform for investigating exploratory partnerships

1) Exploratory partnerships

Inter-firm collaborations are considered as a critical factor in the new generation of R&D (Miller and Morris 1999) and consequently, they have been extensively studied under various perspectives (see e.g. Kogut 1988; Brouthers, Brouthers et al. 1995; Gulati 1998; Hagedoorn 2002; Ring, Doz et al. 2005). However, most of the research concerns dynamics of collaboration when projects or partners roles are well defined. Contrastingly, more and more companies establish partnerships very early phases of innovation, even before the object of the collaboration is precise (Maniak and Midler; 2008). Such partnerships have been qualified as *exploratory* by Segrestin (2006). In such partnerships, degree of uncertainty is very high and the ability to manage efficiently collaboration is much more complicated. Segrestin characterizes exploratory partnerships with a double precariousness: the object of collaboration and the rules and responsibilities are not stabilized and should be progressively determined. Participants are searching both for "coordination" (a common project, job sharing, resource allocation, efficiency) and for "cohesion" (rules to settle disputes, to share the outcome, entering-leaving conditions). In the following section we overview MIL's structure, objectives and organization in order to show that it is a platform for building exploratory partnerships.

2) A brief overview of MIL

MIL is an innovation platform located in Grenoble, France, next to French Center of Research in Micro-nanotechnology, MINATEC. The platform was created in 2003 by France Télécom (a telecommunication operator), ST Microelectronics (semiconductor company) and Commissariat à l'Energie Atomomique (CEA, a French government-funded technological research organization). It has been progressively opened to new partners. Today, MIL is composed of six industrial partners - EDF, CEA, Renault, Bouygues, Rossignol and a confidential partner - and two academic partners from Grenoble - Université Pierre Mendès France and Université Stendhal. The participants of MIL aims at discovering and mastering new competencies (in particular, in the domain of micro-nanotechnology) through the attempts of creating innovative applications (products or services) for their base field of activity. For instance, the former industrial partner, Essilor, one of the world's leader eyeglass producers, explores concepts such as "informative eyes-glasses" which strongly challenges the very identity of the dominant design of the glasses (Abernathy and Utterback 1978), but also, the core competences of the firm (integration of electronic competences) (Veyrat 2008).

The idea of creation of an external structure as a solution to cope with exploration and exploitation is well known (Volderba 1996; Foss 2003). Beside that, a variety of reasons motivate partners of MIL to invest in the platform. We can note among other things that, by becoming member of MIL, partners meet industrial partners of unfamiliar business sectors, they expect thus to get new ideas. This is consistent with the social network theory of innovation where it is accepted that new ideas comes from *structural holes* – that is, from the interaction and idea exchange of persons from different social networks with different preoccupations (Burt 2004). MIL is also the opportunity for partners to access to new knowledge – in particular, the micro-nanotechnology of CEA. Thus, one common motivation for industrial partners of MIL is to localize and to acquire (or, at least, to access) advanced technological knowledge that may open new possibilities for their companies, and, by the same process, improve and reaffirm the image of their company as a hi-tech firm. From the view of the research partners, this creates

an opportunity to finance their research and produce immediately applicable results, or industrialize potentially useful technological advances that are not yet disseminated.

Moreover, the platform allows partners to share risks and costs generated by technological innovation attempts. Each year, partners accept to invest a same amount of money and allocate same human resources. However, this last aspect induces the necessity to reach consensus on the innovation fields to be explored so that a maximum number of partners can benefit from the result. Due to the large scope of partners' businesses, a variety of project ideas covering a large domain like telecommunications, home automation, sport and leisure or even electronic interfaces are proposed and reaching a consensus on which project to pursue is not straightforward.

A steering committee, composed of the representatives of all the partners, meets regularly to address these issues and to supervise the activity of MIL, the advancement of different projects and discuss courses of actions for newly emerging project ideas. The steering committee is a platform where interests and concerns of different partners are voiced and discussed. For each project idea (or, more generally, innovation field) whether it would be accepted, and if yes, participants, their responsibilities and the sharing of the outcome is negotiated.

We can observe defining characteristics of exploratory partnerships within MIL: Participants of MIL committed themselves to this partnership *prior* to any discussion and negotiation about a common project. Although each partner signs a contract to participate, the cohesion is a recurrent issue that needs to be revised in every steering committee meeting. Since the partners' interests may be very different and every emerging project idea does not necessarily concern all the partners, it may be difficult to find a common operational direction for the next working period. Partners, who have all invested in the platform, require having an equal utility from the knowledge and projects produced. Considering the diversity of the partners' core business this is not always possible and the tensions this may cause need to be reconsidered and resolved periodically. Between every committee meting, rather classical coordination issues follow where it is aimed to achieve objectives determined by the steering committee. This *cohesion-coordination cycle* in a context where the object and the conditions of the partnership is in constant revision and negotiation are the defining traits of an exploratory partnership. Nevertheless, MIL has a particular status due to the multiplicity of the partners, the constant renewal of projects and the continuous nature of the initiative – all of which are not usual characteristics of exploratory partnerships. From this perspective, MIL appears like an extreme case, which is not fully explained by the sole notion of exploratory partnership. Rather, *MIL seems like a partnership for exploring exploratory partnerships*! It is a platform for establishing exploratory partnerships.

IV- Dynamics of exploratory partnerships: co-construction of C and K spaces

1) A typology of exploratory partnerships based on C-K distances

Partners of MIL are from different and unrelated sectors. Generally, both their product ranges and competencies have little or no intersections. In terms of CK design theory, the difference between their innovation fields (new products (or new services)) can be explained by a distance between their concepts spaces. Similarly, the difference in competencies can be regarded as a distance between knowledge spaces. This notion of distance between respective C and K spaces can be used to characterize the particularity of the exploratory partnerships that take place within MIL: they are *distant C-distant K partnerships*. Is this the unique start configuration for exploratory partnerships? One can imagine other possibilities as well; Fig2.

- Case 1. (close C - close K). This is a situation where partners have approximately similar knowledge and competencies and are situated in same business. An example would be the merging of Renault-Nissan, two companies from the industry automotive with knowledge about the same domains.
- Case 2. (close C – distant K). Partners explore similar concepts but have different competencies. For instance, we can imagine cooperation between two energetic utilities, one providing gas and the other electricity for domestic market. They

collaborate to develop new air-conditionning system with significantly different core competencies.

- Case 3. (distant C – close K). This is the case where companies with similar competencies but different concepts decide to explore partnership opportunities. This might be the case when companies from different markets using the same core technology (e.g. injection molding) decide to co-innovate.
- Case 4. (distant C – distant K) This is the case of MIL, industrial partners are coming from different business and co-explore new concepts or/and competences.

No matter the initial start configuration, an exploratory partnership can begin between partners. We next report on some basic mechanism of co-exploration.

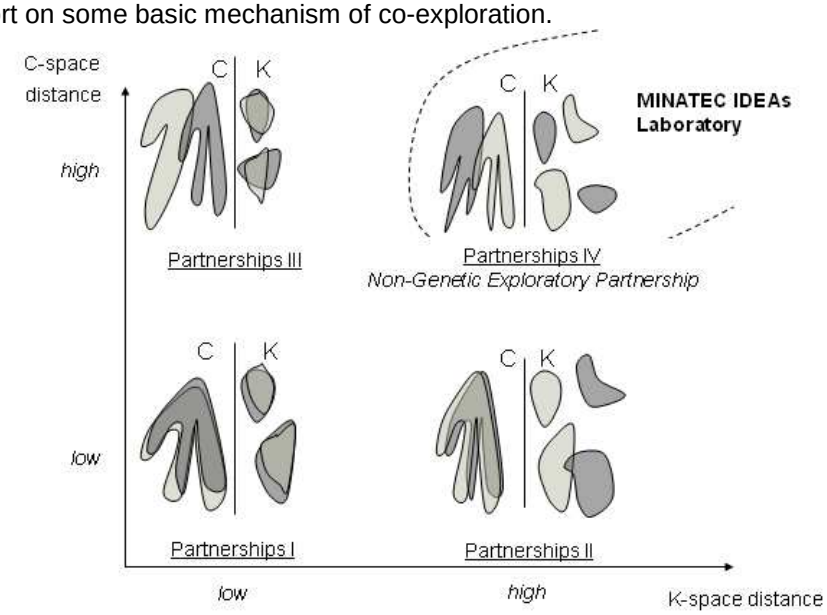


Fig2. A typology of exploratory partnership based on CK design theory

2) Basic mechanism of co-exploration: finding or building *collective* partitions and *complementary* knowledge

In order to co-innovate, each partner needs to explore other partners' C and K spaces to discover synergies. The process of co-exploration corresponds to a process of finding or creating intersections or complementarities between the respective concepts and knowledge of the partners. This can be characterized with

a) a process of **matching**; a process aiming at detecting existing intersections of partners' C spaces or K spaces.
b) a process of **building**; a process of creating intersections either in C spaces or in K spaces.

Globally, these two types of processes can be seen as *attempts to reduce C or K distances.* Those intersections could be more or less difficult to obtain. In practice, we have observed two basic ways of reducing this distance; Fig3 and Fig4.:

- **Investigating a new technology to explore knowledge of the partners.** An expert about a specific technology is asked to make a presentation to the partners of MIL (Gillier and Piat 2008). On the one hand, partners question and try to understand details of the technology; on the other hand, they try to come up with creative and useful ways of applying it. Project ideas thus created do not necessarily concern the partner who created it; it may as well appeal to other partners. The effort to understand the reach and potentialities of a technology often necessitates learning about the technology as well as partners' related knowledge – which allows approaching different knowledge spaces (Gillier and Piat 2008).
- **From specific concepts to general, unifying innovation fields**. Partners exchange about their mutual interests and project ideas. Usually, at the beginning, the exchanged concepts are very specific to the partner voicing the idea. Progressively, abstractions from the exchanged concepts are made to reach more general and unifying concepts,

which may cover entire innovation fields (e.g.; starting with ideas specific to each partners core business, partners can reach broad concepts like “mobile energy” or “vision exchange”).

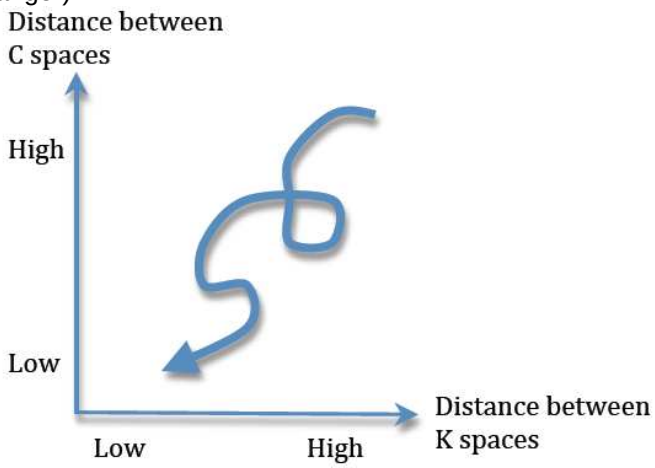


Fig3. Exploration of concepts and synergies resulting in the reduction of "distance" between concept and knowledge spaces of partners

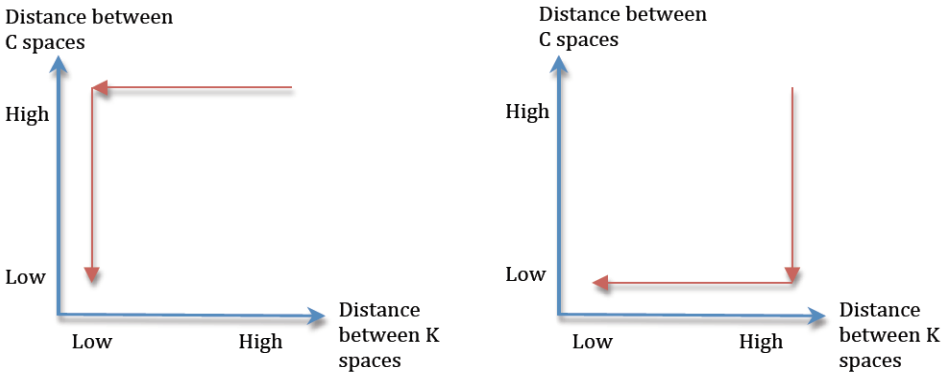


Fig4. Two basic strategies for approaching or connecting concept and knowledge spaces

3) Co-exploration of C spaces: restructuring C spaces to reach collective partitions

As we have seen, a first way to engage collaboration is *to explore intersections in C-spaces*. By matching or building existing C spaces, partners aim to discover interesting concepts (or simply, sub-properties) on which it is promising to work together. Such properties may be called ***collective partitions*****.** Les us consider an example from the "energy project"; Fig5. The core idea of this project has emerged out of some informal exchanges between two of the partners. Discussing about their own projects (smallest possible walkman and a “living” seat) partners discovered that, in both project there was a need to reconsider the way energy was provided for the corresponding artefacts. Firm A, looking for ways to reduce the size of the walkman concept, was considering ideas (or partitions) such as “not using a battery”, “using ambient energy”, etc. Firm B, working on the concept of living seat – a seat that reacts to its user needs, was interested in using sensors and other electronic equipment in the design of their seat. They needed a built-in energy source and they were considering potential solutions (including mobile sources). Realizing that the energy source was a common issue to both projects and anticipating other partners might be interested as well, they decide to submit a proposal to steering committee about an energy project. Some preliminary investigation showed that CEA might offer some interesting new technology for innovative ways of producing energy. As a result of discussions, each partner declared the project as a common generic axis on which to work together and accepted the investment.

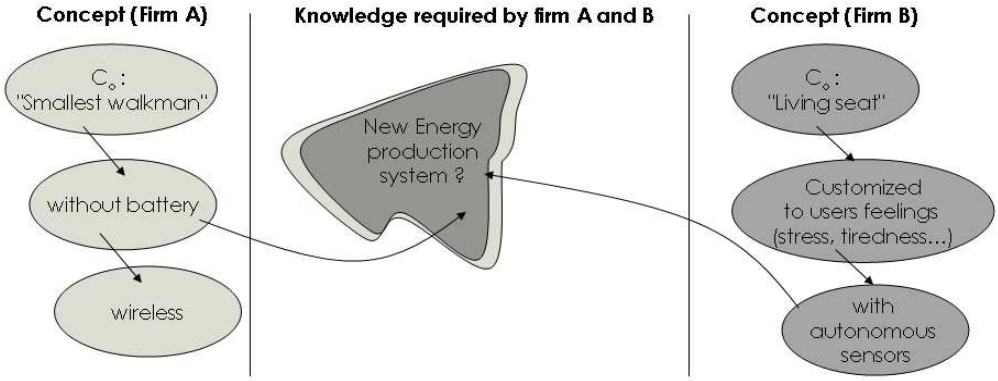


Fig5. Detecting collective partitions

One of the interesting points with this project is the restructuring of the partners' concept spaces. In fact, *matching and building common partitions has the result of co-constructing a new and common C space*; Fig5. We see here the dynamic nature of partitioning: in order to reach a common project, partners reorganize the order of the partitions: *the priorities of the partitions in the respective concept spaces of the partners changes.* In the example, at the beginning, the partitions related to the energy issue were *lower* in the object description and were not seen as a central issue. Consequently, each partner could have continued the design with his or her own initial concept without necessarily innovating on the energy topic. However, as soon as the energy issue has been identified as a collective partition, it became central for both partners. It is interesting to note that this reversal of priorities does not prevent or hinder in any way the partners from pursing their original project. On the contrary, advances made on the energy project open up new possibilities for both partners since *cross-partitioning effects* become possible; Fig6. For instance, Firm A can decide to design a "smallest walkman customized to user's feeling" and may use firm B's knowledge regarding stress measurement.

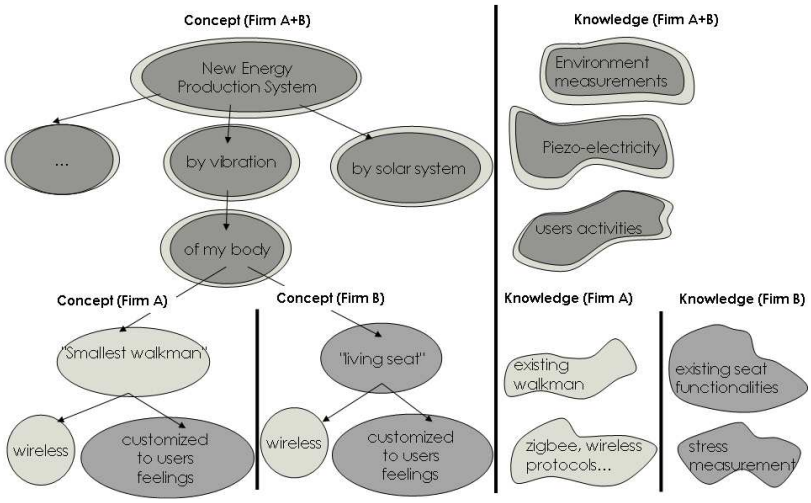


Fig6. A new Concept space : highly superposable

4) Co-exploration of K spaces: New knowledge as a medium for exploring partner's old knowledge

Collaborative opportunities may also appear by joint exploration of new knowledge. At MIL, this is undertaken systematically. Experts from CEA about various specific technologies are invited to MIL to present the specificities of that technology. Partners question and try to understand details of the technology. A methodological approach is applied routinely to understand both the properties of the technology and its possible functions and uses (Gillier and Piat 2008). One such exploration has been realized for micro-fluidic technology; Fig7. The partners learnt from

the expert the functions of this technology such as "moving drops". Discussion and exchanges with the expert made appear more details such as the size of the drops that can be moved or the properties of the liquid (e.g. solvents can be moved as well).

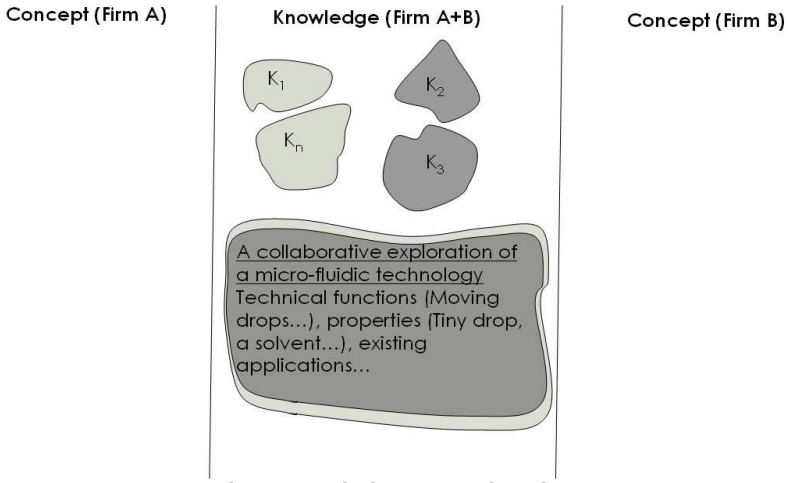


Fig7. Knowledge co-exploration

Such newly discovered knowledge, combined with each partner's old knowledge, may allow the ideation of new concepts. For instance, an on-going innovation process about avoiding micro-bacteria may be expanded with the "cleaning" functionality that the new technology offers. The new uses and functions discovered during the exploration of the new technology can thus be injected to (the C spaces of the) on-going innovation processes; Fig8.

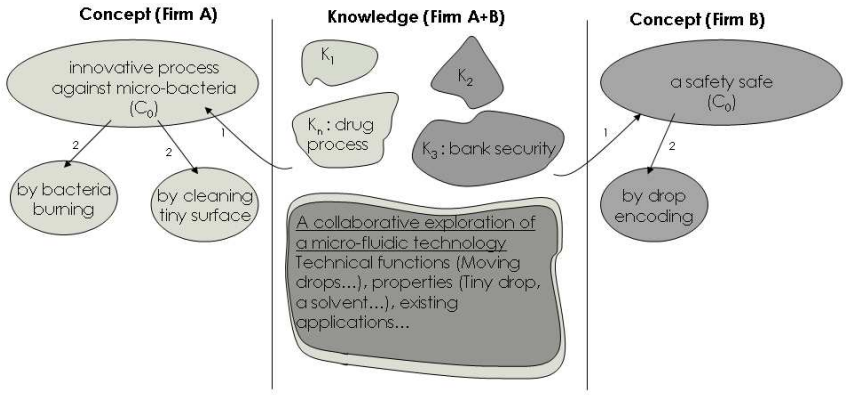


Fig8. Transfer knowledge to C-spaces

The effort to understand the potential uses and impact of a new technology allow learning about the technology *but also about partners' related knowledge.* This may create further synergies since project ideas created during this exploration do not necessarily concern the partner who created it; it may as well appeal to other partners.

V- Discussion

The paper analyses the dynamics of exploratory partnerships in the context of MIL - a partnership of several leading French companies and a large size hi-tech government laboratory specialized on microelectronics and nanotechnology. Based on our observations within a participatory research approach, we identified MIL as a platform for exploring exploratory partnerships. In a theoretical modelling effort, the data we gathered were structured on the basis of CK design theory. A typology of exploratory partnerships has been proposed based on the distances of product ideas and competencies (viz. C-K distances). MIL has been described as a

distant C-distant K partnership. We described some basic mechanisms of co-exploration that aims to reduce the distance. In particular, we showed that:

a) In order to reach a common project (in C space), partners explore each other's concepts to detect collective partitions that allow building common concept spaces.

b) New knowledge (e.g. about new technologies) can be used to explore partners' capabilities and competencies (partners' K space) to establish common innovation topics.

The dynamics that we described in this paper raises a number of questions regarding the notion of open innovation (Chesbrough 2003) and cognitive distance (Noteboom, Van Haverbekeb et al. 2007) criteria for selecting partners. These will be addressed in future extensions.

References

Abernathy, W. and J. Utterback (1978). "Patterns of Industrial Innovation." Technology Review **80**(7): 40-47.

Birkinshaw, J., J. Bessant, et al. (2007). "Finding, Forming, and Performing : creating networks for discontinuous innovation." CALIFORNIA MANAGEMENT REVIEW **49**(3, spring): 67-84.

Burt, R. S. (2004). "Structural Holes and Good Ideas." American Journal of sociology **110**(2): 349.

Brouthers, K. D., L. E. Brouthers, et al. (1995). "Strategic alliances; Choose your partners." Long Range Planning **28**(3): 2.

Chesbrough, H. W. (2003). Open Innovation: The New Imperative for Creating and Profiting from Technology.

David, A., Ed. (2001). Intervention research as a general framework for management research. The new foundations of management sciences. Paris, Vuibert FNEGE.

Doz, Y. L. (1996). "The Evolution of Cooperation in Strategic Alliances : Initial Conditions or Learning Processes ?" Strategic Management Journal **17**(Special Issue: Evolutionnary Perspectives on Strategy): 55-83.

Foss, N. J. (2003). "Selective Intervention and Internal Hybrids: Interpreting and Learning from the Rise and Decline of the Oticon Spaghetti Organization." ORGANIZATION SCIENCE **14**: 331.

Gillier, T. and G. Piat (2008). Co-designing broad scope of technology-based applications in an exploratory partnership. Design Conference, Dubrovnik.

Glaser, B. and A. Strauss (1967). Discovery of Grounded Theory. Strategies for Qualitative Research, Sociology Press.

Gulati, R. (1998). "Alliances and Networks." Strategic Management Journal **19**(4).

Hagedoorn, J. (2002). "Inter-firm R&D partnerships : an overview of major trends and patterns since 1960." Research Policy **31**: 471-492.

Hatchuel, A. (2001). "The two pillars of new management research." British Journal of Management **12**: 33-40.

Hatchuel, A. and B. Weil (1999). Design oriented organizations:Towards a unified theory of design actvities. 6th International Product Development and Management Conference, Churcill College, Cambridge, UK.

Hatchuel, A. and B. Weil (1999). Pour une théorie unifiée de la conception, Axiomatiques et processus collectifs. CGS Ecole des Mines, GIS cognition-CNRS.

Hatchuel, A. and B. Weil (2002). La théorie C-K: Fondaments et usages d'une théorie unifiée de la conception. Colloque Sciences de la Conception, Lyon.

Hatchuel, A. and B. Weil (2003). A new approach of innovative design : an introduction to C-K design theory. ICED'03, Stockholm, Sweden.

Hatchuel, A. and B. Weil (2007). Design as Forcing:Deepening the foundations of Ck theory. 16th International Conference on Engineering Design - ICED 2007, Knowledge, Innovation and Sustainability, Paris, France.

Kogut, B. (1988). "Joint Venture : Theoretical and Empirical Perspectives." Strategic Management Journal **9**(4): 319-332.

Le Masson, P., B. Weil, et al. (2006). Les processus d'innovation- Conception innovante et croissance des entreprises Paris, Hermès.

Maniak, R. and C. Midler (2008). "Shifting from co-development to co-innovation." International Journal of Automotive Technology & Management **8**(4): 449.

Miller, W. and L. Morris (1999). Fourth Generation R&D, Edition John Wiley and Sons.

Noteboom, B., W. Van Haverbekeb, et al. (2007). "Optimal cognitive distance and absorptive capacity " Research Policy **36**(7): 1016-1034

Powell, W. W., K. W. Koput, et al. (1996). "Interorganizational Collaboration and the Locus of Innovation: Networks of Learning in Biotechnology." Administrative Science Quarterly **41**(1).

Ring, P. S., Y. Doz, et al. (2005). "Managing Formation Processes in R&D Consortia." California Management Review **47**(4): 137-156.

Schein, E. (1987). The clinical perspective in fieldwork. Newbury Park, CA, Sage.

Segrestin, B. (2005). "Partnering to explore: the Renault-Nissan Alliance as a forerunner of new cooperative patterns." Research Policy **34**(5): 657-672.

Segrestin, B. (2006). Innovation et coopération interentreprises - Comment gérer les partenariats d'exploration ?

Paris, CNRS Editions.

Strauss, A. and J. Corbin (1990). Basics of qualitative research: Techniques for developing grounded theory. Newbury Park, CA, Sage Publications.

Teece, D. J., G. Pisano, et al. (1997). "Dynamic Capabilities and Strategic Management." Strategic Management Journal **18**(7): 509-533.

Veyrat, N. (2008). Les usages dans la lunette - Co-concevoir des produits et des usages innovants. Ecole doctorale "Sciences de l'Homme, du Politique et du Teritoire" n°454 . Grenoble, Université Pierre Mendès-France**:** 419.

Volderba, H. W. (1996). "Toward the flexible form : how to remain vital in hypercompetitive environments." Organization Science **7**(4).

Yin, R. K. (1990). "Case study Research : Design and Methods." Applied Social Research Methods Series **5**.

Global thought for the design of products in the MIE and SME in Colombia

P. Sánchez[1,*], D. Millet[2]

[1] Industrial Design, Pontificia Universidad Javeriana, Bogota, Colombia

[2] Laboratory LISMMA, Université du Sud Toulon Var, Toulon, France

[2*] Corresponding author: pmsanchez@javeriana.edu.co, +57.1.627.50.26

Abstract: Current world phenomena have taken to the organizations to reach a greater competitiveness. For Colombia, a better competitiveness of its MIE and SME supposes actions around the resources, the definition of added values and implementation of an innovation culture through product design.

Within this frame, diverse actors emerge revealing a problematic around the understanding, appropriation and integration of the product development process like means to obtain a better competitive positioning. It is as well as it take place the interest to achieve a better understanding of MIE and SME perceptions and requirements in order to put forth actions, since the product design, to respond to its needs about its competitiveness.

Thus, it is propose a project focused in the following aspects:

- Vis-à-vis the comprehension, to seize how is held the products development, which factors catalyse it and how are they taken into account in the making decisions process.
- About the appropriation, to establish, with the participation of a hundred of companies of diverse productive sectors, a common language that facilitates the multi-actors and multilevel interaction.
- To structure the whole of the actions leading to promote a dynamics of participation supporting the definition of competitive advantages, to answer the integration problem.

Keywords: MIE and SME competitiveness, Competitive advantages, MIE and SME needs understanding

I- Introduction

For J.M Ivañez (Ivañez 2000), factors like the opening of markets, mobility, connectivity and information have been essential in the search for new opportunities in the markets, making it a must to consider the environment of the organization to get a better response.

In Colombia the base of the economy are the MIE and SME. According to the Colombian Association of Small Manufactures –ACOPI-, theses represent 96% of all companies in the country, they generate 46% of new manufacturing jobs, they account for 25% of the GIP of the nation and they produce 25% of total exports and 33% of the non-traditional exports (Cardona and Gano 2005).

Taking into consideration the conditions of the market, MIE and SME are obligated to define and execute actions in reference to the product, the production, the distribution and marketing in order to respond in an effective way to the demand of global markets that are more competitive everyday.

The importance of MIE and SME in the Colombian economy makes it necessary to understand, from the standpoint of the small business owners, the requirements needed for its competitiveness and in this way, propose mechanisms that favour a better understanding of the design of the products.

II- How does the product design and competitiveness come together?

According to Danielle Quarante in her book “Elements of Industrial Design”, the Concepts of assembly line production and mass consumption bring together de design of products to the needs of consumption and socioeconomic and technical factors of the context; even though, with the rise of cybernetic in 1947, the design of products became an economic factor articulated to production. It was at that moment, according to Andres Sicard, when design acquires the massive dimension; under the same line of thought, Leonor ARUCH claims that the

design of products has acquired a connotation for organizations, that rises above the formal aspect -even when this is considered part of the process of conception and design of new products-.
And thus, base on Tomas Maldonado, the definition of design adopted by International Council of Societies of Industrial Design, is, “design consists on coordinating, integrating and articulating all the factors that, in one way or another, participate in a constituting process of the shape of a product in the industry”, making evident three aspects that show the importance of the integration of the design in products in the structure and organizational policies (Danielle Quarante 01).

The first aspect is the sum, through which all the properties functional and aesthetic or symbolic of the product and that are related in the formal aspects, are considered part of the concept. The industrial aspect, tied to the industry, industrialization, and mass production; and the technical productive one, through which design takes into account the availability of resources (productive structure, hand labour, know how, etc.), technology integrated to the product and to production with the objective of obtaining more efficiency of the conception process and the development of the product. In this way the design of products, has assumed the responsibility of the culture of the objects, of the masses, promotion de the visual culture and the integration of the informational cultures.

The authors we have made reference to, comply that the strategies in favour of competitiveness must focus on the generation and diffusion of knowledge and innovation, promoting the growth of a productive system, diversity and better strategic positioning of the offer and service of products of the territory.

The fulfilment of these strategies depends greatly on the constant investment of qualified human resource, the appropriation and use of technology, of strategies of know-how and market tendencies and consumption that closely relate to the context; for which the coming together of the design of the product and its management becomes a fundamental factor to obtain competitive advantages in the market.

In fact, the relationship with the design of the product starts to be conceived around the knowledge, where the information -as to the object of knowledge- becomes a motor of development. This is how the acquired and produced discernment by the process of conception and production, becomes a factor of competitiveness that positions the design of products as an indispensable element of organization.

According to Jose Maria IVAÑEZ GIMENO, the integration of developing economies in the globalise markets, the accessibility of means of transportation and communication and the importance acquired by communication, have forced organizations to enter the global market to participate in it.

This is how the process of conception and the development of products, characterized for being interdisciplinary, calls on to divers areas of knowledge (marketing, psychology, ergonomics, engineering, among others) that are articulated under de systemic relationship of three fundamental factors, human beings-environment-object, and the creative activity of the design of products.

The analysis of this relationship, form a disciplinary vision found in the situation of use. This way the ergonomic, anthropometrics, cognitive factors among others, of the user and his or her relationship with the context allows identification of the needs of use and of the definition of determinants and requirements in the functional, aesthetic, symbolic and semiotic factors of the object. On the other hand, the psycho socio and cultural aspects, the desires and expectations of the consumer and the dynamics of the marketing context, lead us to the definition of the attributes that consumers perceive and that defines values that reinforce the interest of the product.

But in order to respond to the new conditions of the context, the process should integrate, to it’s initial enclosure, a vision toward the consumer, the market and the product with the objective of

responding to more demanding and selective consumers, through different products where the added value turns into an essential argument in the market.

There for, the analysis of the strategic vision centres on the dynamics and tendencies of the market focused on acquiring a greater knowledge of the context and the consumer (management of the market, psychology of the consumer) so as to identify opportunities of development, define differential values directed towards a better strategic positioning and identify new ways of marketing, distribution and sales. Also, it will concentrate on the rationalizing of the productive processes (engineering, technology) allowing advantages in the reduction of costs, diversity of the portfolio of products and the optimizing of the productive scheme from the existing resources.

Thus, competitiveness acquires a sense in the development, maintenance and improvement of the capacity to response facing the conditions of context and design of the products as a means to reach better strategic positioning in the economic environment.

III- Who participates in this dynamic and what problems emerge from this relationship?

Changes in the environment have made organizations more receptive in their world interaction, turning competitiveness into an objective and the achievement of greater competitiveness, a necessity for productive structures.

This situation has taken competitiveness to social-economic, political, academic and business contexts generating a change in the way of thinking of diverse economic agents and focusing the interest on making the productive and economic infrastructure stronger so that it can participate more efficiently in global markets.

According to studies on the initiatives of development made in Europe (Benett, Storh) and Latin America (Alburquerque, Aghon), actions are taken in making the productive system more efficient in such a way that it obtains a growth in the capacity of response of the consumer and production market. And, in that sense, in a better use of the resources (natural, historic, cultural, etc.) of the regions to make territories and their organizations more competitive.
For Gorgio Fua, actions must be taken to strengthen manufacturing and organized capacity through the qualification and instruction of human and productive capital; for Vasquez Barquero, mechanisms that make diffusion of knowledge and innovation easier are those that increase the enterprising capacity of productive structures.

Finally, these actions need active policies; strategies and actions in diverse levels, whose interaction according to Vasquez Barquero ”produce a synergic effect that stimulates the sustained growth of productivity and economical and social progress (Vasquez Barquero 05).”

These approaches show productive and academic sectors to be fundamental agents in the dynamics of growth, where the interaction of its participants (businessmen, teachers, investigators, students, consultants), allows the pursuit of development of I+D projects, allows the exchange and search for actions that generate a mutual benefit: a better quality levels, the transfer of new technologies, the fulfilment of production schemes, the defining of new attributes and product value and the conception and development of new products, looking for a participation in global markets.

Taking into consideration the diversity of participants that emerge from this relationship, a communication problem arises amongst them caused by the different approaches and levels of comprehension of the competitiveness and its relationship with the designing of the products as a means to gain better competitive positioning.

What we have just seen makes relevant the importance to inquire, from the small businessman’s point of view, how the development of products is brought about so that a unified language can be proposed from the products design and with the participation of

different areas of knowledge, that allows actions to be taken in reference to competitiveness inside the organization.

IV- A common language: how to obtain it?

Studies made in Europe (London Press 95, Ministère de l'industrie 95, Portales 98) and other newcomers in Latin America (Brazil 98, Argentina 03, Colombia 04), make evident various aspects: In the first place, the lack of knowledge, on behalf of small businessmen, of the contribution of the design of the product, turns it into a last resource.
In second place, that the integration of product design in the organizations must be supported by mechanisms and actions that facilitate the understanding of the management of the design of the product, of the factors and systematic relationships that make it up.

There for, this project comes from the interest to give the organizations a new vision of the value of the products design management, so that through its integration, the organizations can turn it into a factor that leads to better competitiveness.

In order to obtain this, it is necessary to come to a better understanding of the perceptions and needs of the MIE and SME facing the process of development of products: how product are developed? What information is necessary? How to acquire this information?, with the purpose of proposing a language that allows the them to take action in reference to the competitiveness inside the organization and from the management of the design of the product.

The design management, defined as "the set of activities directed to coordinate human and material resources (inside and out) necessary to bring about projects, programs, politics or strategies of design, related to business objectives (Pibernat)"; leads us to observe the interrelation of the factors: consumer – environment – product, surrounding the productive activity in relation to the context, arriving at a definition of two approaches for the analysis.

The first centres in investigating the actions that follow up to the recognition of new opportunities of development of the product (captive market and potential) and the added and competitive value for it´s products (current and potential); the niche and segments of the market and thus the opportunities of optimizing of productive resources, the access to external resources. The participation with divers productive sectors (current and potential) and the accessibility to policies of advancement, with the objective of responding the initial question.

The second element of the analysis focuses on the relationship between these factors, allowing three macro factors to be identified:

- The **product,** as a first factor arises from the relationship between the consumer and the market environment. This allows for the defining of new opportunities of intervention and also to identify niches of the market and opportunities to identify the portfolio of the product. The analysis allows strategic actions to be focused on the factors of differentiation and attributes for the development of products.

- The second factor, the **market**, comes from the relationship between the consumer and the product. This analysis makes evident the real strategic positioning of the offer (own and of the competition), the expectation and motivations of the consumer. It guides actions towards the development of new products, the attractive factors and competitive position in the market.

- From the relationship between the productive environment and product emerges a third macro-factor: the **productive environment**. The analysis of this relationship allows the getting to know and evaluation of the response capacity of the productive structure installed and additionally allows the projecting of possible actions oriented towards association, clusters and alliances that potentialize the productivity

V- Conclusion

In the Colombian context, promoting and sustainable development of the country, as a means to better the conditions and the quality of life, has implicated the planning and execution of policies, strategies and conducting actions that raise competition of the divers productive structures and resources of the country.

For this, coming closer to the organizations and identification of aspects like the capacity of answer before the fluctuations of the market, allow envisioning the capacity of the organization to generate innovation and to define attributes of the product that allow a greater impact before the context. In this way, knowing the level of access to the divers resources, knowledge and the capacity, with the objective of promoting the diffusion of knowledge, of the innovation and association. All this, with the objective to reach a greater comprehension of how and why factors intervene in the process of design and the development of products.
Considering the sectors and participants called upon to take part in this activity it is important to define -from de design- a common and comprehensible language that facilitates the interaction in multiple levels, between participants. It is necessary for this, with the participation of hundreds of small businesses, to understand the current focus in regard to the process of development of products that lead to the structuring of a set of actions that promote a dynamic that will withhold the definition of competitive strategies that strengthen the response of the productive structures of the country in reference to competitive global markets.

References

Aguayo G. Francisco and Soltero S. Victor M. (2003) Metodología del Diseño Industrial, un enfoque de la ingeniería concurrente. México: ALFAOMEGA Ra-Ma.

Cardona A. and Gano G. (2005) Dinámica industrial, crecimiento económico y PyMES. Observatorio Nacional de la Economía Latinoamericana 50.

Ivañez J., José M. (2000) Gestión del diseño en la empresa. Madrid: Editorial McGraw-Hill.

Pibernat, Oriol. (Without date) Diseño – Empresa. El diseño como instrumento de innovación y competitividad empresarial. Valencia: ADPV.

Quarante, Danielle (2001) Éléments de Design Industriel. Paris: ECONOMICA.

Vásquez B., Antonio. (2005) Las nuevas fuerzas del desarrollo. Barcelona: Antoni Bosch editor S.A.

Ulrich Karl T. and Eppinger Steven D. (2004) Diseño y desarrollo de productos, enfoque multidisciplinario. Madrid: Editorial McGraw Hill.

A Collaborative Environment as Collective Learning Support

MH. Abel*

[1] Laboratory Heudiasyc University of Technology of Compiègne, Compiègne, France

* Corresponding author: Marie-Helene.Abel@utc.fr, +33 (0)3 44 23 49 50

Abstract: Innovation is a process and not only a result. This process concerns the design of products or new services. It concerns also the emergence, the circulation and the achievement of new ideas. It needs opened mind, creativity, knowledge sharing and continuous collective learning. Collective learning integrates formal and informal learning. Thus different people may learn the same skills in different ways. There are many learning opportunities in an organization like formal course or discussion: learning is an active process where learners build their knowledge and understanding, it is also a social process which proceeds through conversations and interactions. In technology side, the use of Web 2.0 technologies facilitates social networks creation. A social network is in a way a Community of Practice. CoPs, are formed by people who engage in a process of collective learning. This learning can be the objective of the community members or is the results of their interactions. We will present in this article how we developed a collaborative environment associating Web 2.0 technologies, Knowledge Management models and e-learning models as support for CoPs collective learning.

Keywords: Innovation, Collective Learning, Collaborative Environment, Community of Practice, Innovative Technology

I- Introduction

In our current economic context, in order to stay competitive, organizations have to foster innovation. Innovation is a process and not only a result. This process concerns the design of products or new services. It concerns also the emergence, the circulation and the achievement of new ideas. Denning reminds that the application of (old) knowledge almost involves adaptation process which produces new knowledge (Denning, 2000). Such processes need opened mind, creativity, knowledge sharing and continuous collective learning. Collective learning integrates formal and informal learning.
Thus organizations are facing a host of challenging questions (Denning, 2000): How to encourage more dialogue, interaction among employees? How to find out who knows what I need to find out more about something? How to find out what should I be reading to find out more about something? How to find out where is a particular item of information or knowledge within the organization? How to find out who would benefit from communicating with whom?

To answer these questions, we propose to build a collaborative environment based on the association of Knowledge Management model, Collective Learning model and Web 2.0 Technologies. This proposition is justified by the links we made between the three following definition:

- Knowledge Management comprises a range of practices used by organizations to identify, create, represent, and distribute knowledge for reuse, awareness and learning[1];
- Collective learning encompasses different intertwined key activities which are consuming knowledge, connecting knowledge, contributing knowledge and charting knowledge;
- Web 2.0 technologies facilitate social networks creation.

In the following we present links between innovation, Knowledge Management and Collective Learning. Then we specify the role of Web 2.0 technologies can play in the innovation process and why it could be interesting to associate them to semantic web approach. Finally, before to

[1] http://en.wikipedia.org/wiki/ Knowledge_management

conclude, we present the collaborative environment we developed in the framework of the project MEMORAe2.0.

II- Innovation/Knowledge Management/Collective Learning

Innovation is 90% learning and knowledge driven. Knowledge is the most important resources for innovation and the whole innovation process is a series of learning cycles.

According to (Berg Jensen and al, 2007), we can distinguish two modes of learning and innovation:

- STI (Science, Technology and Innovation) mode: this mode is based on the production and use of codified scientific and technical knowledge;
- DUI (Doing, Using and Interacting) mode: this mode relies on informal processes of learning and experienced-based know-how.

The STI mode can be supported by knowledge management strategies that emphasize the use of tools for codifying and sharing knowledge. Knowledge engineering proposes concepts, methods and techniques making it possible to model, formalize, acquire knowledge in organizations for operationalization, structuring or managing in the broad sense. These methods and tools are intended to support the dynamics of knowledge in the organization. One well-known model coming from knowledge engineering and dedicated to knowledge management is Organizational Memory. Extending the definition proposed by (Van Heijst & al, 1996), (Dieng & al, 1998) consider an organizational memory as an "explicite, disembodied, persistent representation of knowledge and information in an organization, in order to facilitate its access and reuse by members of the organization, for their tasks." Thus a collaborative platform based on this model should facilitate knowledge management and the STI mode.

Concerning the DUI mode, it can be supported by strategies that emphasize informal communication for problem-solving and learning.

Let's note that Collective Learning integrates formal and informal learning. It recognises community contribution to the learning process. It includes intertwined activities such as:

- Consuming knowledge: individuals need to be able to identify easily knowledge within the community;
- Connecting knowledge: necessity of using tools that support retrievable and communication around knowledge creation and consumption;
- Contributing knowledge: necessity of using tools that support knowledge creation and sharing;
- Harting knowledge: empowering learners to chart their learning paths for consumption.

Thus collective learning will be facilitate if in a same space organization members can access to formal learning resources and interact about these resources.

Finally, STI mode and DUI mode are complementary; Innovation needs:

- To share explicit knowledge in order to facilitate formal learning,

- To learn from informal interaction (externalization of tacit knowledge). In their research works, (Kodama, 2005) and (Nonaka & Takeuchi, 1995) have shown that innovation process is widely influenced by the capacity of an organization to share tacit knowledge.

To support these needs, extending the definition given by (Dieng & al, 1998), we propose the concept of Learning Organizational Memory for which users' task is collective learning.

Developing a collaborative platform based on this model should facilitate STI and DUI modes and foster innovation.

Thus, in their study concerning the use of Knowledge Management to Drive Innovation, APQC International Benchmarking Clearinghouse (APQC, 2003) discovered 15 causes to promote KM for innovation: Efficient Innovation; Managing technical and scientific information, Centrality of information technology and repositories; More conscious knowledge management; A bias against reuse of knowledge; Expertise locators; Building social capital and spanning boundaries; Enabling work, Communities of practice; Culture change; Human resource practices; KM and learning, External collaboration; KM infrastructure and resources; Measurement. These causes put forward the STI and DUI modes reification and the use of Information Technologies.

III- Technologies Web 2.0

Web 2.0 is a new information technology generation coming from the classical Web which we call now Web 1.0. The main difference between the two generations is the control of contents. With Web 1.0, contents are controlled by the Web master and users can only read them. With Web 2.0, users are readers as well as contributors. Thus, when they contribute, users create contents that are aggregated automatically to form new contents. These ones are the result of the contribution of all participants.

Web 2.0 technologies offer to users distributed collaboration facilities (O-Reilly, 2005). They can be distinguished from web 1.0 technologies by various characteristic features:

- Community. Web 2.0 applications enable users to collaborate and share information easily.
- Mashups. An aggregation of various contents, data coming from different sites.
- Ajax[1] or LAMP[2]. These sets of technologies enable web masters to create responsive user interfaces.

The most well-known web 2.0 applications are wikis and blogs. For few years wikis have been used in organizations as tools that promote sharing and collaborative creation of Web contents. A wiki is a collection of web pages designed to enable anyone who accesses it to contribute or modify content, using a simplified markup language[3]. On a basic level wiki is a website comprising the collective work of many authors. Wikis are crucially different from blogs, which are also used in organizations, in that users can modify any entry, even material posted by others. Unlike to a wiki, a blog is a website maintained by only one individual, with regular entries of commentary, descriptions of events, or other material such as graphics or video[4].

Let's note that, although wikis are a tool for creating contents, they serve at the same time collaborative skills learning. Thus, wikis offer to users a collaborative environment where they work with others, create a community and operate in our society that we can qualify of cognitive society. In such a society the creation of knowledge and information is increasingly becoming a group effort (Richardson, 2006).

Thus Web 2.0 technologies facilitate the creation of social networks. A social network is in a way a community of practice. According to (Wenger, 2008), communities of practice are formed by people who engage in a process of collective learning. This learning can be the objective of the community members or is the results of their interactions. They provided a new approach, which focused on people and on the social structures that enable them to learn with and from each other. Because they offer informal training situations, organizations have interested in this approach for few years. Wenger explains this interest by different reasons:

[1] Acronym for Asynchronous JavaScript and XML
[2] Acronym for Linux, Apache, MySQL and PHP
[3] http://en.wikipedia.org/wiki/Wiki/Wiki
[4] http://en.wikipedia.org/wiki/Wiki/Blog

- Communities of practice enable members to take collective responsibility for managing the knowledge they need.

- Communities among members create a direct link between learning and performance.

- Members can address the tacit and dynamic aspects of knowledge creation and sharing, as well as the more explicit aspects.

- Communities are not limited by formal structures: they create connections among people across organizational and geographic boundaries.

Let's note that in their study (Correia & al, 2008) recommend "organizations promote the role of Virtual Community of Practice as sources of innovation which create competitive advantage by developing a culture where knowledge sharing and reuse of information is recognised and valued." According to (Dubé & al, 2006), Virtual Communities of Practice, without excluding face-to-face meetings, rely on Information Communication Technologies to connect their members.

Finally Web 2.0 technologies emphasize two core aspects: microcontents and users. They give identity to contributors. These ones can create easily microcontents without specific competences. Web 2.0 technologies offer to users distributed collaboration facilities (O-Reilly, 2005) and then should support Virtual Communities of Practice. Due to their intrinsic characteristics, Web 2.0 technologies seem to be a good candidate for foster innovation in an organization: forum, wiki, blog, RSS[1].

IV- Links between different webs

Web 2.0 applications and services enable non-specialist users to contribute to the Web. This leads to new requirements of Networked Information Retrieval (Zhang, 2007). In the Web 2.0 context, due to the lack of semantic relation among contents, massive information produced by users can't be processed. In the context of the Semantic Web, data on the web are published in machine-readable format using shared ontologies to give them a formal semantic, and inter-linked on a massive scale (Shadbolt & al, 2006). Thus data can be retrieval easily. Publishing data using languages dedicated to the Semantic Web (RDF[2], OWL[3] or Topic Maps[4]), has different advantages:

- Makes data retrieval by using a standard query language (SPARQL[5], TMQL[6]);
- Facilitates the integration of data from different resources;
- Allows the creation of machine-readable links between data resources.

However, create Semantic Web applications necessitates specialist skills and it is a brake to their growth!

Web 2.0 and the Semantic Web have been previously considered as independent and even competing for the evolution of the Web. Due to their strengths and their weakness, we believe, like several colleagues, that these two visions are complementary:

"The Semantic Web can learn from Web 2.0's focus on community and interactivity, while Web 2.0 can draw from the Semantic Web's rich technical infrastructure for exchanging information across application boundaries." (Ankolekar & al, 2007, p 825).

According to the same authors, this is possible by providing simple, well-structured Web forms through which users can add comments, information to a web site without requiring any

[1] http://en.wikipedia.org/wiki/RSS_(file_format)
[2] http://www.w3.org/RDF/
[3] http://www.w3.org/2004/OWL/
[4] http://www.topicmaps.org/
[5] http://www.w3.org/TR/rdf-sparql-query/
[6] http://www.isotopicmaps.org/tmql/

knowledge of the underlying technologies or principles. By following this approach, an environment should enable users to create content that is immediately usable on the Semantic Web. Users are guided and place their contribution in such a way that elicit semantic annotations are automatically associated.
Semantic wikis are an illustration of this complementarity. They try to combine the strengths of Semantic Web and Wiki technologies. The wikipedia definition[1] specifies that a semantic wiki is a wiki that has an underlying model of the knowledge described in its pages. Regular wikis have structured text and untyped hyperlinks (such as the links in this article). Semantic wikis allow the ability to capture or identify further information about the pages (metadata) and their relations.

In the same way, we propose the concept of semantic forum. A semantic forum is an internet forum that has an underlying model of the knowledge described in its content. Such content is formed by users' questions and answers about specific topics concerning the forum themes. All the questions and their answers are microcontents that we can described by the author, the date of posting but also by the theme and the topic it is about. In the case of an innovation context, in order to not be disconnected with the innovation process, topics will be defined in advance by the organization. All this knowledge is defined semantically although users don't aware of this definition and language used to do it.

V- The project MEMORAe2.0

In the framework of the project MEMORAe2.0, we associated knowledge engineering model, semantic web approach and web 2.0 technologies to build a learning collaborative platform supporting STI and DUI modes of learning and innovation (Leblanc & al, 2007). We developed the platform E-MEMORAe2.0 based on the Learning Organizational Memory model.

The project MEMORAe2.0 is an extension of the project MEMORAe (Abel & al 2006). Within the project MEMORAe, we were interested in the knowledge capitalization in the context of organizations and more precisely the capitalization of the resources related to this knowledge. We particularly focused on the way organization actors could use this capitalization to get new knowledge. To that end, we developed the platform E-MEMORAe as support for e-learning. In such a platform resources are indexed to knowledge organized by means of ontologies. Using these ontologies, actors can acquire knowledge by doing different tasks (reading reports, books, accessing web site…). We used Topic Maps (XTM, 2001) as a representation formalism facilitating navigation and access to the resources. The ontology structure is also used to navigate among the concepts as in a roadmap. The user has to reach resources that are appropriate for him. In such a platform, the general principle is to propose to the users at each step, either precise information, resources on what they are searching for, or links allowing them to continue their navigation through the memory. To be more precise, the user interface (see Figure 1) proposes:

- Entry points (left of the screen) enabling to start the navigation with a given topic: an entry point provides a direct access to a topic defined by an ontology concept of the memory and consequently to the part of the memory dedicated to topics.
- A short definition of the current topic: it enables the learner to get a preview of the concept and enables him to decide if he has to work it or not.
- A part of the ontology describing the current topic is displayed at the screen centre.
- A list of resources (bottom of the screen) which contents are related to the current topic: they are ordered by type (books, course notes, sites, examples, comments, etc.). Starting from a topic, an entry point or a topic reached by the mean of the navigation, the user can directly access to indexed resources. Descriptions of these resources help the user to choose among them.
- Navigation history: it enables the learner to remind and to be aware of the path he followed before. Thus, he can get back to a previously reached topic if he wants to.

[1] http://en.wikipedia.org/wiki/Semantic_wiki

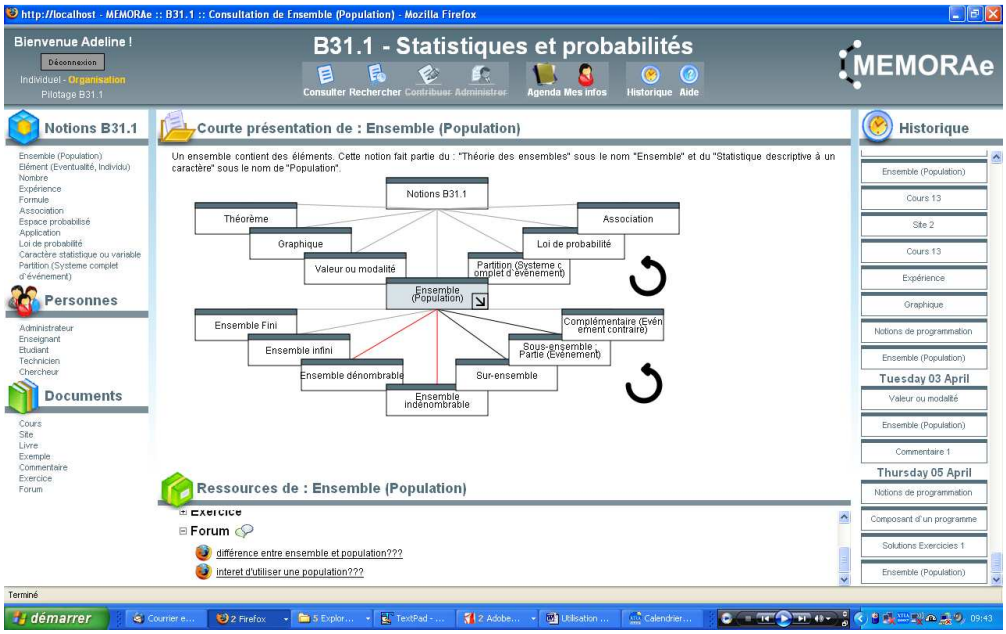


Figure 1: Navigation in the memory (in French).

E-MEMORAe was positively evaluated in academic contexts (Abel & al, 2006).

Within the project MEMORAe2.0 we are interested in developing memory collaborative functionalities and social processes. To that end, we take into account different levels of memory and different ways to facilitate exchanges between the organizational actors. In such an environment, we distinguish knowledge and resources of:

- The whole organization;
- A group of individuals in the organization – the organization is constituted of different groups of individuals even if it can be seen as a group itself;
- An individual.

To that end, we modelled different level of memories. In order to facilitate and to capitalize exchanges between organization members we added the concept of exchange resources (currently, we tested the forum concept). These concepts extended the MEMORAe ontology. The idea is to foster and capitalize exchanges concerning any topics of the organization defined by ontologies.

For example, when actors need to know who works on a project, they have to access to the information relative to the project itself. A way to do this is to navigate through a concept map based on an ontology defining the organization knowledge. According to their access rights, they can visualize space/memory resources. In case of exchange resources (forum), they can exchange ideas or information (externalization of tacit knowledge).

In order to put into practice this modelling we developed a new environment called E-MEMORAe2.0 (cf. Figure 2). It re-uses general principles of E-MEMORAe and gives the possibility of learners to have a private space and participate to share spaces according to their rights. All these spaces (memories) share the same ontologies but store different resources and different entry points. Resource transfers can be done following two mainly ways:

- Users can visualize different spaces/memories content at the same time and make a drag and drop to transfer a resource from a specific memory to another one.

- Users can interact about specific topic via exchange resources. Currently we developed two kinds of exchange resources: semantic forum and semantic e-mails. We plan to develop semantic chats and semantic agendas.

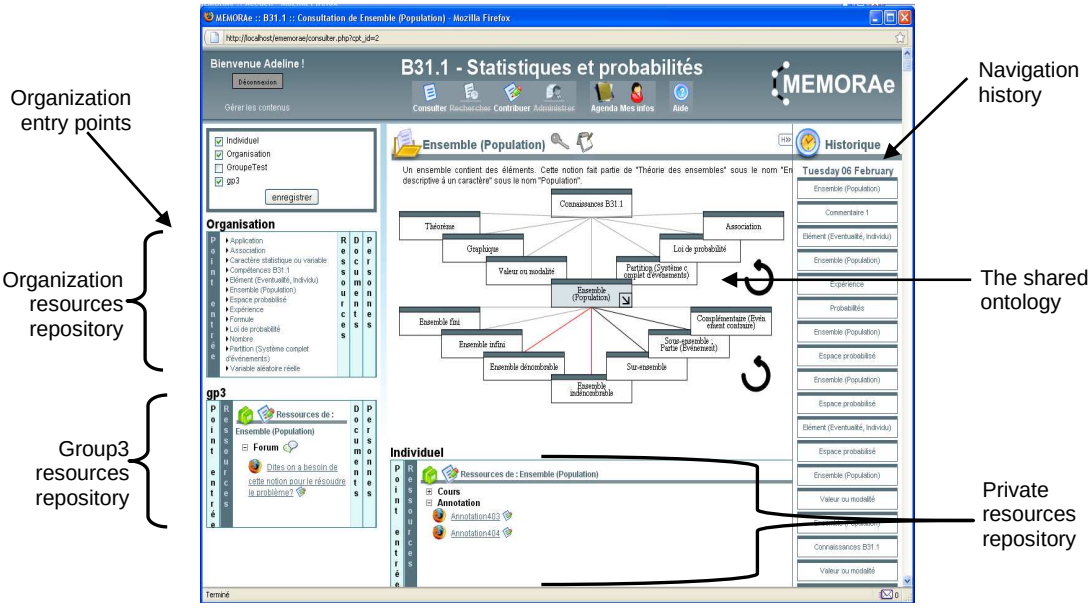


Figure 2. E-MEMORAe2.0 navigation interface (in French)

In order to facilitate users' exchanges, we modelled a semantic forum as a set of microcontents or micro-resources. We decided to manage these micro-resources like any resources in the memory. Thus we defined the concept of MEMORAe-Forum which is an exchange resource and is linked to one micro-resource of question type and 0 or n resources of answer type. Each micro-resource is indexed by a concept of the application ontology and has an author, a date of contribution (cf. Figure 3).
In such a way, each group memory has its own forum organized around the shared ontology. Each interaction is automatically indexed without users do anything. All the forum contributions are distributed in the resources space among the other resources. Users don't access to the forum itself but to the memory resources space and then select resources of MEMORAe-Forum type to participate to the forum. So there is not explicit forum like traditional forum where users can visualize all members' contributions about any topics. If necessary it will possible to build this presentation form with the functionality export we plan to develop.

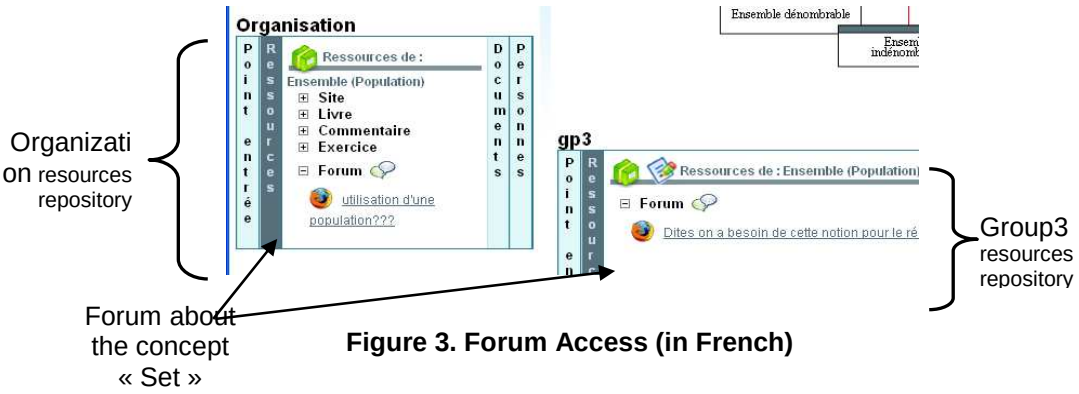


Figure 3. Forum Access (in French)

VI- Conclusion

In this paper we presented links we made between knowledge management, collective learning, semantic web, and web 2.0 technologies to build a collaborative environment. We proposed concepts of learning organizational memory and semantic forum as support for Virtual Communities of Practice. In the same way, to facilitate interaction et tacit knowledge externalization, we plan to introduce semantic blog and RSS. Currently our environment is used by academics. We have contact with industrials in order to evaluate such an environment to foster innovation in their organization.

References

Abel M.-H., Benayache A., Lenne D., and Moulin C. (2006) "E-MEMORAe: a content-oriented environment for e-learning." In *E-learning networked environments and Architectures: A Knowledge processing perspective.* by Samuel Pierre (ed.) Springer Book Series: Advanced Information and Knowledge Processing, pp 186-205.

Ankolekar, A., Krötzsch, M., Thanh Tran, Vrandecic, D. (2007) "The two cultures: mashing up Web 2.0 and the Semantic Web." Proceedings of the 16th International Conference on the World Wide Web, WWW2007, Banff, Alberta, Canada, May 8-12, 2007, pp. 825-834.

APQC, (2003) "Using Knowledge Management to Drive Innovation." ISBB 1-928593798, APQC Publishers.

Berg Jensen, M., Johnson, B., Lorenz, E., Lundvall, B. (2007) "Forms of knowledge and modes of innovation." ScienceDirect, Research Policy, pp. 680-693.

Correia, A., Mesquita, A. and Paulaos, A. (2008) "Innovation through Virtual Communities of Practice: motivation and constraints in knowledge-creation process." Proceedings of the European Symposium on Innovative Management Practices, ERIMA08, Porto, November 6-7, 2007, Portugal.

Denning, S. (2000) *The Springboard: How Storytelling Ignites Action in Knowledge-Era Organizations*, Butterworth Heinemann, Boston, London: 2000.

Dieng, R., Corby, O., Giboin, A. et Ribière, M. (1998) "Methods and tools for corporate knowledge management." In Proceedings of the 11th workshop on Knowledge Acquisition, Modeling and Management (KAW'98), Banff, Canada, pp. 17-23.

Dubé, L., Bourhis, A., and Jacob, R. (2006) "Towards a Typology of Virtual Communities of Practice." Interdisciplinary Journal of Information, Knowlegde, and Management, (Alex Koohang), 1, 69-93, 2006.

Kodama, M. (2005) "New knowledge creation through leadership-based strategic community – a case of new product development in IT and multimedia fields." Technovation, 25, pp. 895-908.

Leblanc, A. and Abel, M.-H. (2007) "Using Organizational Memory and Forum in an Organizational Learning Context." In *proceedings of the Second International Conference on Digital Information Management ICDIM'07*, pp. 266-271.

Nonaka, I. and Takeuchi, H. (1995) "The knowledge-creating company." New York: Oxford Press.

O'Reilly, T. (2005) "What is Web 2.0 – design patterns and business models for the next generation of software." http : //www.oreillynet.com/lpt/a/6228

Richardson, W. (2006) "*Blogs, wikis, podcasts, and other powerful web tools for classrooms*." Thousand Oaks, CA: Corwin Press.

Shadbolt, N.R., Hall, W. Berners-Lee, T. (2006) "The semantic Web revisited." IEEE Intelligent System, 21, (2006) pp. 96-101.

Van Heijst, G., Van der Spek, R. and Kruizinga, E. (1996) "Organizing Corporate Memories." In B. Gaines, M. Musen eds, Proceedings of KAW'96 Banff, Canada, November, pp. 42-1 42-17, 2006.

Wenger, E. (2008) http://www.ewenger.com/

Zhang, Z. and Tang, J. (2007) "Information Retrieval in Web 2.0." In IFIP International Federation for Information Processing, Volume 251, Integration and Innovation Orient to E-Society Volume 1, Wang, W. (Eds), (Boston:Springer), pp. 663-670.

Managing academic programs portfolio innovation

M. Levi-Jakšić[1*], M. Jaksic[2],

[1] University of Belgrade Faculty of Organizational Sciences,

[2] University Megatrend, Faculty of Business Studies,

* Corresponding author: majal@fon.bg.ac.yu

Abstract: The turbulent changes and demands of knowledge based economy and society pose very strong challenges for higher education and universities. Their role is central in creating high quality and quick response to the learning society needs.

University needs to adapt and to respond, but also to be proactive and to fulfill its leadership role establishing open, innovative and flexible strategies for the future. This means development of new academic programs satisfying the future needs of the society based on the fundamental principles of scientific development, but also strengthening capacities in satisfying current needs of economy and society for high quality mass education.

The paper correlates the basic principles of technology portfolio management to the sphere of high education academic programs portfolio management. The new concepts of competitiveness, efficiency, effectiveness and quality management are very intensively penetrating the educational sector, especially the sphere of high education. The strategic analysis of academic programs portfolio based on technological portfolio management and strategy principles is oriented at developing tools and methods for the best high education practice. It contributes to the creation of the overall identity, basic profile, better positioning and sustainable development strategy for high education organizations. The concept of new, innovative and cooperative university continuously developing and diversifying the academic portfolio is introduced and characterized through its main features.

Key words: high education, new technologies, service oriented strategies, academic programs portfolio, diversification, competitiveness.

I- Introduction

The high education processes enable the realization of the academic programs (AC-s). The prestige of modern universities depend on the set of programs offered to the “customer” – students, but also, on the processes that enable efficient and high quality deliverance of the study programs.

The shortening of product life-cycle as the characteristic feature of modern development trends has strongly affected the academic portfolio dynamics. Universities need to change, to innovate and transform continuously in order to keep their leading role in economy and society. The need to be flexible and to diversify constantly into new scientific fields and to introduce new disciplines has put much pressure on high education and resulted in the recognition of the need to introduce the principles and methods of modern management into the academic sphere. Abiding to the quality standards is a step forward, but the process needs to be further developed.

The resource based, competence oriented approach is well suited to strategic management of the academic programs portfolio – ACP at high education organizations (HEO) , primarily due to long-term orientation and competence based competition as the basic characteristics of high education processes and sector.

The discussions are frequently aimed at resolving the dilemmas and strategies are aimed at establishing the right ,”fit” and ,”measure” between very complex and often opposed factors affecting the high educational sector: standardized vs. flexible and specific educational practices and programs; diversified vs. focused high education institutions; elitist vs. mass education processes; long-term, strategic orientation vs. quick response and adaptability to current needs; responsive vs. proactive academic strategies.

II- Diversification vs Integration factors affecting University transformation

The most important characteristic of the new position, role and nature of universities is their strong correlation with the needs of the society, the demand of their almost immediate competence to answer these needs and to develop competencies to anticipate and to create future needs. These needs will be focused around a clear demand to have population permanently involved in the learning process, essentially the reason why we have the new paradigm of «learning society». The new mission and roles of the university mean development of competencies.

1. Innovativeness and innovative strategies as the main features of technology management, completely applicable to high education institutions. Developing innovative competencies and strategic innovation management are at the core of successful, highly ranked universities in the world today. The competencies to innovate are crucial in delivering high education service in the domain of what and how the service is delivered.

2. Competencies in creating cooperations, networks and all other forms of collaboration with the environment, in essence are motivated by the necessity to strengthen technological, market and innovative potentials of institutions, firms and societies. Building diversified forms of cooperation, networks and alliances with different agents in their environment is another competence strongly related to competitiveness of modern universities enabling also different potentials of diversifying the academic programs portfolio.

3. Competencies for the almost immediate answer to different needs, which means responsiveness, flexibility and adaptability practically meaning that the population is permanently involved in the learning process having in mind the need for mass and life-long learning needs and the central role of universities in this process. Universities will have to adapt in the following manner:

a) changing and multiplying the forms and mechanisms of the delivery of teaching;

b) changing the content being taught;

c) integrating purpose into the contents and forms of teaching;

d) evaluating efficiency and effectiveness as quality indicators of university success and managing university in accordance to these results.

4. Competencies to provide proactive role to anticipate and to create future needs, oriented towards leadership in learning society. Creativeness as the goal of higher education means combining production, learning and research to provide a better environment for training creative talent.

III- Academic program life-cycle analysis

The academic program life-cycle curve is created along the dimensions of time (horizontal axes) and market attractiveness (vertical axes).

The dimension of time is related to development potentials and perspectives of an AC. Characteristic phases are recognized in the life-cycle, the introduction phase, steep rise, peak and slowdown with gradual downward tendency. By elapsing of time, the scientific relevance and capacity of the AC program to offer the latest scientific results are diminishing, it is becoming more or less obsolete and needs to be ”re-engineered”. The life-cycle curve has passed its peak position and is sloping downwards, coming to the end of life - stage where it should be incrementally/radically innovated or abandoned.

Figure 3. AC life-cycle curve

Figure 3 represents a AC life - cycle curve with four characteristic positions-phases:

A – Introductory phase- introducing new AC, fresh start with high growth potentials, but still needs to be recognized by the market – potential students and employers;

B – steep rise in market attractiveness as the AC becomes well positioned and recognized by its scientific relevance and contributions comprising knowledge well adapted to the needs;

C – peak position, high market attractiveness is reached, the AC is well recognized on the market and well positioned bringing prestige and competitive advantage to HEO - considered the best time to introduce changes;

D – gradual slowing-down and falling of interest in the AC – high time to innovate AC or abandon.

The life-cycle analysis has provided ground to develop the basic principles of optimal academic programs portfolio. It is emphasized that each AC goes through mainly three characteristic stages in relation to their contribution to the overall success of HEO, according to the position in the ACP: 1. emerging AC; key AC, and 3. base AC.

Emerging AC is the one with high growth potentials but still in the early stages of market penetration with high scientific relevance and of current interest.

Key AC has a steep rise in growth with great perspectives, still high in scientific relevance.

Basic AC is the one generating the highest success on the market but with low perspectives and high expectancy of becoming obsolete in the near future, facing the slowing down and gradual falling of its current relevance and interest.

In time dynamics, each AC develops the character of being emerging, key and basic AC within the ACP strategic perspective.

At each point of time, it is argued that HEO should at least offer three AC-s positioned as emerging, key and basic in its portfolio in order to keep its prestigious, competitive role in the high education market. It is also suggested, that if resources and competencies allow, more than one AC differently positioned is necessary. It is strongly recommended that the emerging and key AC-s are the strategic orientation for developing the ACP.

Figure 4 represents the three basic AC-s in ACP enabling continuous development of HEO, but also enabling at all points of time the three differently positioned programs.

Figure 4. Diversification of ACP into three generic AC-s: emerging -E, key -K and basic -B

IV- ACP- Innovation strategy

ACP strategy deals with strategic AC dimensions based on the following analysis:

1. identifying the list of existing AC-s in the HEO ACP;

2. determining competitive effect of each AC in the portfolio, by determining its market position and potential and scientific position and potential in comparison with competitors. Difference is made between AC-s in relation to their marginal, core or key roles in acquiring competitive advantage.;

3. Life-cycle positioning of each AC in the portfolio (Levi-Jakšić, 2001, pp. 119.) The objective would be to develop the ACP in such a way to obtain diversified structure in relation to different positions within the life-cycle, that would enable continuous support in generating market success.

Continuous ACP analysis and development determines its innovation strategy:

- new AC-s are introduced in early stages in the life-cycle, emerging AC-s with marginal effect to competitiveness at present, but with high potentials and expectations in the future;

- mature (basic) AC-s are innovated or abandoned and substituted gradually as their life-cycle position is nearing the end of the curve;

- key AC-s are nurtured and developed to their full potential in terms of building the competencies and developing it in relation to the market.

V- Conclusion

All three main aspects of university activities are undergoing deep and radical transformation.

1. Teaching is experiencing transformation and is being moving away from being done predominantly in the lecture mode to placing greater emphasis on learning, i.e. focusing on the student as an active part of the process interacting more with other students, working in teams, active in learning outside the classroom. Faculties are having a guiding, advisory role rather than simple conveyance of knowledge through lecture.

2. Research is becoming more oriented to areas that are relevant to societal needs and more interdisciplinary approaches to discovery.

3. Service orientation means a shift in focus; from a more internal looking organization to a more external focus. The service university is characterized by several features: professional schools, short tailor-made courses, contracting of services and funding by contracts.

References

Ansoff, I., McDonell, E., Implanting Strategic Management, Prentice Hall, 1990.

Archibugi, D., et al. (1999) “Innovation Policy in a Global Economy”, Cambridge University Press

Booz, Allen, Hamilton, Diversification: A Survey of European Chief Executives, Booz, Allen and Hamilton Inc., 1985.

Cantwell, J., Gambardella, A., Granstrand, O., The Economics and Management of Technological Diversification, Routledge, 2004.

Fagerberg, J., Mowery, D.C., Nelson, R.R., The Oxford Handbook of Innovation, Oxford University Press, 2005.

Fai, M.F., Corporate Technological Competence and The Evolution of Technological Diversification, Edward Elgar, 2003.

Grant, R.M., Contemporary Strategy Analysis, Balckwell, 2005.

Leoncini, R., Montressor, S.(2003) “Technological Systems and Intersectoral Innovation Flows”, Edward Elgar

Levi-Jakšić, M., Strateški menadžment tehnologije, FON, 2001.

Levi-Jakšić, M., Jakšić, M. (2003) “Managing cooperative and innovative firm competencies”, GBATA, USA

Slack, N., Lewis, M., Operations Strategy, Prentice Hall, 2002.

Sundbo, J., The Strategic Management of Innovation, Edward Elgar, UK, 2001.

Towards a New Way of Doing Strategy: How Spanish Companies incorporate innovation in Their Strategies

M. Astigarraga[1,*], S. Azua[1]

[1] Consultant, B+I Strategy SL, Spain

* Corresponding author: mastigarraga@bmasi.net, +34944052041

Abstract: The paper focuses on how Spanish companies incorporate innovation management in their strategies. It specifically centres its attention on three important issues: the elements to define innovative strategies, the way to create the pre-requisites for an innovative company and the innovation management processes.

Based on an analysis of the state-of-the-art literature and our experience, the study makes a theoretical and empirical contribution to existing models for strategy and innovation management. The model is then tested using a two-phase empirical approach. For the first phase response to a questionnaire has been received from more than 200 Spanish companies testing their innovation capacity and the impact of innovation on strategy. The second phase consists of a selected number of in-depth interviews to executives from very innovative Spanish companies.

The study points out as a conclusion how most Spanish companies realize their need of innovation, but they do not tend to realize a need for radical innovation. Besides, most companies develop incremental innovations with a partial vision of the company. They should also be searching for innovation in every single area and increase the global number of innovation projects. Finally, most companies do not manage innovation as a process by itself or just manage it from the R&D or Marketing perspective. Spanish companies need to dedicate more resources, focus their efforts and turn innovation into a basic capability. The “Innovation Kite” Strategic Innovation Model summarises these recommendations among others in order to help companies to develop a constant innovation capacity.

Keywords: Strategy, Innovation Model, Innovation management

I- Introduction

Today companies are faced with intensifying competition and a turbulent economic environment, with rapid rates of technological change and associated shorter product cycles, and the increased blurring of long-established industrial boundaries. However, when thinking about the future, many firms define strategies very similar to the past and non-differentiated from their competitors. Moreover, they don’t pay attention to build a constant innovating capacity for the company, and they don’t define actions, practices and structures to acquire that capacity in the following years. As a consequence, companies are suffering from decreasing margins and declining profitability, and will continue to do so if they don’t incorporate innovation management in their strategy.

There are several reasons that explain why companies fail to define innovative strategies. In some cases, companies are too focused on cost reduction and efficiency gains, and they don’t see the need to change and innovate to generate new value to customers. In other companies, there is not a culture that favours innovation, with very fragmented structures, very past-oriented leaders, and no incentives to being creative and experimenting new ideas. In many companies innovation is considered important but it is led to some specific groups, with no clear vision and scope, and with no innovation management processes, structures and techniques at the firm level. Many other companies lack of relational capital, and invest in research alone, not working in networks, not with suppliers and customers.

Nevertheless, we can find many companies that have succeeded in defining innovative strategies and in developing radical new products in a very profitable and sustainable way. Each company is different but we can find several common characteristics to these innovative companies:

- Clear and stable vision (with longer time horizons and greater market focus).
- Each employee knows what the organisation's strategy means for them in their job.
- Demanding customers and/or true consumer insights are incorporated in the innovation process already at the idea stage
- Core competencies are identified, maintained and leveraged. Strong capabilities, linked to current operations and strategy.
- Best practice Innovation Management System is put in place
- Evaluation and Measurement is a constant feature
- Strategic planning is linked to project planning and execution, so that options are evaluated on basis of strategic fit, rather than financial indicators.
- Learning from experience is emphasized, with experimental rather than analytical approach to markets, and more tolerance of failure

II- Objectives of the study

Considering the relevance of innovation and the different approaches and behaviours of firms, our study is focused on how (to what degree) Spanish companies incorporate innovation management in their strategies. We focus on three important issues:

- Which are the elements to define innovative strategies
- How to develop innovation capacity: the pre-requisites for an innovative company
- How to manage innovation: processes and portfolio

III- Literature review

There is extent literature about innovation and strategy issues, with several trends and empirical studies which can be particularly useful for our study. The literature on innovation is varied in approach and this is one of the main problems in working towards a general innovation theory (A. Read, 2000). Most research has contributed to innovation knowledge through uni-dimensional studies such as new product development, new process development or adoption and diffusion. Cooper (1998) attributes much of the confusion surrounding innovation to the uni-dimensional construct, lack of comparative study, and failure to clearly define innovation.

There are different definitions of innovation. Common to all definitions is that an innovation is something new or novel. An implied feature of innovation is that it must be useful (Cooper 1998). This distinguishes an innovation from an invention, which may not have practical application. One main point of contention is whether innovation is a process or an outcome (Rodgers 1983). Another difficulty in a specific definition concerns the timing of an innovation relative to other firms in the industry. Does a firm need to be the first mover or innovator to be considered innovative? Does it need to be in the first x% of adopters (Rodgers 1983).

Many problems with defining innovation can be related to the dimensions of innovation identified by Gopalakrishnan and Damanpour (1997). Some dimensions are the types of innovation (products vs. processes, radical vs. incremental, technical vs. administrative), the stages of innovation (generation of innovation and adoption of innovation, and level of analysis (national, industry, organisational, group or individual level)

In our research we view innovation from the perspective of the organisation and with a multi-dimensional approach. We consider innovation as the transformation of knowledge into money, as the adaptation or adoption of anything new that is being transformed or incorporated into products, services, processes, systems, structures, brands, IP, etc. i.e. into anything that the customer and/or consumer is willing to pay for. We see innovation as the sum of invention and commercialisation.

Considering the broad range of issues related to managing innovation, a focus on the most important ones is very much needed. A good overview of the main challenges is given in (Jonash & Sommerlatte, 1999):

- Intellectual property is becoming increasingly difficult to protect and preserve measure and manage.
- Business – even entire industries – is no longer insulated from the competition, and innovation leadership is difficult to sustain.
- The nature of competition itself has shifted to cost leadership in many industries, and reengineering-driven cost reductions have overwhelmed many innovations initiatives.
- Technological advances have radically altered the old view of research-and-development techniques, leaving many traditional R&D departments mired in yesterday's key competencies and technologies.
- Traditional research-and-development managers focus primarily on internal operations, while the extended enterprise, which includes suppliers, partners, and customers, often remains unmanaged.

As we conducted an empirical study with a survey to Spanish companies, we considered several studies on innovation which have incorporated a questionnaire and survey. Anthony Read (2000) has summarised some interesting empirical studies from several authors: Atuahene-Gima (1996), Balbontin at al (1999), Yamin at al. (1999), Soderquist et al. (1997), etc. In addition, we considered the results of several empirical studies with firms both at international and at Spanish level, like the Boston Consulting Group (2003), the Spanish Chamber of Commerce (2005), IESE Business School (2004), etc.

IV- Research methodology

Based on the literature review and our experience, we have made a contribution to existing innovation models. The members of the study team have more than 20 years of experience in consulting, as well as close link to the academic and university world. This has helped us to conceptualize the different elements of the innovation model, so that it can be useful for helping companies to define innovative strategies and develop innovation capacity and systems.

In order to test the model we have used a two-phase empirical approach:

- Response to a questionnaire has been received from more than 200 Spanish companies, evaluating how innovative Spanish companies are, which barriers they are facing to develop an innovation capacity and which actions and tools they are implementing in order to increase their innovation capacity and implement innovation management systems.
- A selected number of in-depth interviews have been done to executives from six very innovative Spanish companies: Panda Software, Barceló Hoteles, Ficosa, CAF, Ros Roca and Europastry. These interviews have resulted in a series of case studies included in this research.

In addition, at the beginning of the project an expert group was formed and has met in key milestones of the research project, giving their opinions and suggestions along the study

V- Major findings of the questionnaire to Spanish companies

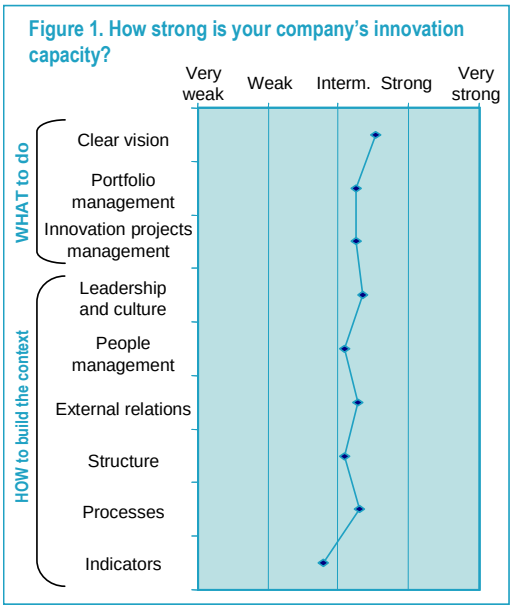
Strategic importance of innovation:

When asked about their strategic priorities, increasing profitability and reducing cost come before increasing innovation capacity. 72,5% of respondents indicated that increasing profitability was very important, while 52,7% indicated that increasing the innovation capacity was very important among their strategic priorities.

Types of innovations:

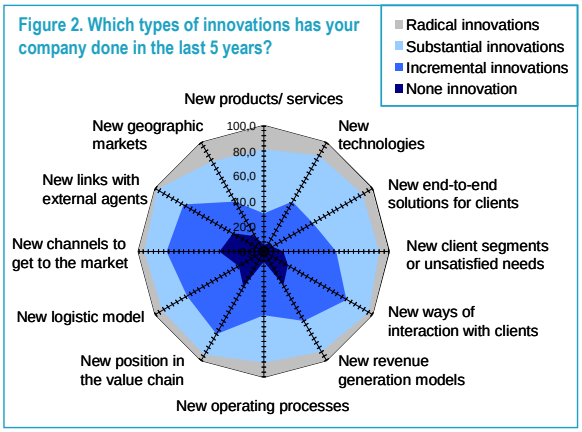
Most frequent innovations are in new products and services, in new technologies and in new operating processes (around 95% of companies have carried out these types of innovations during the last 5 years). Less frequent innovations are in new revenue models, new position in the value chain and new market channels (around 30% have not innovated in these fields in the last 5 years).

Most innovations introduced by companies in the last 5 years are incremental or substantial innovations. On average, only 11,2% were radical innovations, while respondents consider this should increase to 19,7% in the desired future.



Resources for innovation and results obtained:

Respondents consider that more employees should participate in innovation activities, from average 10,2% of staff to desired 18,1%. 29% of respondents are dissatisfied with the financial returns from their innovation investments. On average, respondents consider that the benefits generated by the innovations launched in the last 5 years should increase from current 20% to desired 32%, and that removed or retired new launches should decrease from current 8% to desired 2%.



Innovation capacity development:

Although there are considerable differences between the respondents, the elements in which Spanish companies seem to be stronger are defining a clear vision, and leadership and culture. The elements in which they are weaker are using indicators about innovation, having a structure that supports innovation and managing people to get all their innovation potential (specially promoting rotation and entrepreneurship, and giving people time and space to think about the future).

External relations to innovate:

Very few companies use relations with clients and providers to innovate (less than 9,65% of respondents). Most frequent relations are with Governments and Universities (more than 50%)

Main barriers to innovation:

The most important barriers companies face to innovate are day-to-day pressure (absorbing most time from executives), lack of internal resources dedicated to innovation and short-term results pressure, which makes difficult to invest in innovation projects with medium and long term expected results.

VI- Conclusions to the study

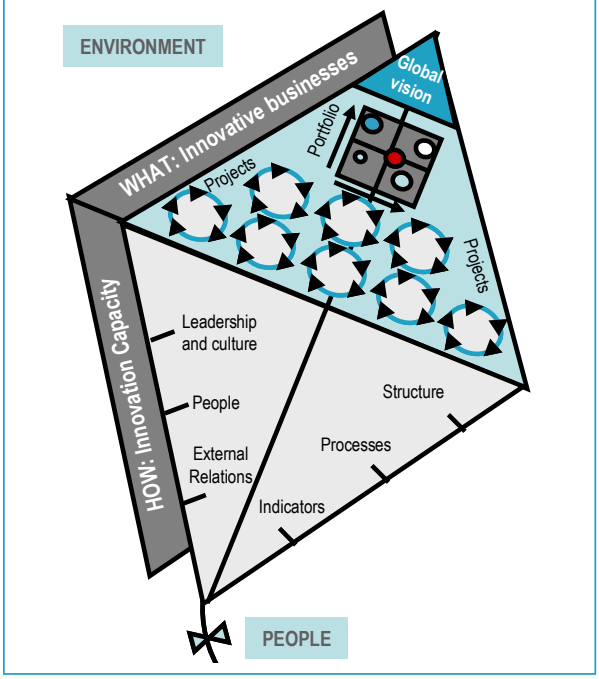
The study points out as a conclusion how most Spanish companies realize their need of innovation, but they do not tend to realize a need for radical innovation. Besides, most companies develop incremental innovations with a partial vision of the company. They should also be searching for innovation in every single area and should increase the global number of innovation projects. Finally, most companies do not manage innovation as a process itself or just manage it from the R&D or Marketing perspective. Spanish companies need to dedicate more resources, focus their efforts and turn innovation into a basic capability. The "Innovation Kite" Strategic Innovation Model summarises these recommendations among others in order to help companies to develop a constant innovation capacity.

"The Innovation Kite" contains several elements and tools, some thinking and change processes that should be adapted to each company. To summarize the main elements of the Model, we can distinguish two main related elements:

WHAT: In which innovative businesses does the company want to work?

- Starting with a **global vision** of the company, flexible and dynamic, showing the aspirations and strategic crux to guide the innovation efforts.
- Leaning on a global and dynamic **portfolio management**, with all the innovation ideas, projects and new businesses
- Supporting and doing several **innovation projects** in different developments steps, with different resources, objectives, etc.

Figure 3. "The Innovation Kite" (Strategic Innovation Model)



HOW: How to develop a constant innovation capacity in the company? To generate the appropriate context so that the company activities (the WHAT) are really innovative, the following elements must be changed or oriented to innovation:

- **Leadership and culture**: what does the management team say and do to create an environment to lead to innovation (support, motivation, setting example, etc.)
- **People**: How is the company provided with the right people for innovation (people with knowledge, creativity, motivation and diversity), how are the incentives and recognitions for innovation.
- **External relations**: With which external agents (clients, providers, institutions, other companies, etc.) does the company have relations for innovation purposes? How are the valuable connections managed?
- **Structure**: Where is the innovation activity located, how is it organized, and how does it receive the support from the business units?
- **Processes**: How are the innovation opportunities generated, financed, developed and evaluated? How is the innovation processes linked to the main business (how the operating processes like human resource management, production, marketing, etc. support innovation?
- **Indicators**: How are the innovation investments, progresses and results evaluated, and how important are the innovation indicators in comparison with other business or budget indicators?

References

Amabile, T.M. (1998), "How to kill creativity", Harvard Business Review on Breakthrough thinking, Harvard Business School Press, Boston.

Anderson, E. and Weitz, B. (1992), "The use of pledges to build and sustain commitment in distribution channels", Journal of Marketing Research, Vol. 29, pp. 18-24.

Atuahene-Gima, K (1996), "Differential potency of factors affecting innovation performance in manufacturing and services firms in Australia", Journal of Product Innovation Management, vol. 13, nº1, pp.35-52.

Azua, S. (1996), "Proyecto Logos: investigación relativa a la capacidad de aprendizaje de la empresa española, KPMG, Bilbao

Azua, S (2000), "Proyecto Intelect: un modelo para la medición del Capital Intelectual", Instituto Universitario Euroforum Escorial, Madrid.

Azua, S. (2001): "Homo Faber, Homo Sapiens. La verdad sobre la gestión del conocimiento", Esade, Barcelona.

Azua, S. (2005) La gestión del conocimiento y del capital intelectual de las organizaciones como elemento clave de la mejora de su competitividad y de su reputación corporativa, Revista Gestión del Capital Intelectual, vol. 2, Madrid.

Azua, S (2005) "La gestión del capital intelectual, un instrumento al servicio de la competitividad de las organizaciones", Conocimientos clave para los gestores de tecnología e innovación pp.150-155, Cluster del Conocimiento, Bilbao

Balbontin, A, Yazdani, B, Cooper, R. & Souder, WE. (1999) "New product success factors in American and British firms", International Journal of Technology Management, vol. 17.

Cesari, L, Conacy, M, Roloff, TW (2002), Pipeline/ portfolio best practices yield higher profits. "Signals of Performance, 3 (1)

Chandy, RK and Tellis GJ (1998), "Organizing for radical product innovation: the overlooked role of willingness to cannibalise", Journal of Marketing Research, Vol. 35, pp. 474-87

Chandy, RK and Tellis, CJ (2000), "The incumbent's curse. Incumbency, size, and radical product innovation", journal of Marketing, vol. 64, pp. 1-17

Cooper, R. (1994) "Winning at new products", Perseus Books, Reading, MA

Cooper, J. R. (1998), "A multidimensional approach to the adoption of innovation", Management Decision, vol. 36, nº8, pp. 493-502

Christensen, C.M (1997), "The innovator's dilemma", Harvard Business School Press, Boston, MA.

Christensen CM, Anthony SD, Roth EA (2004), "Seeing what's next: using the theories of innovation to predict industry change", Harvard Business School Press, Boston, MA

Gopalakrishnan S. & Damanpour, F. (1997), "A review of innovation research in economics, sociology and technology management", Omega, International Journal of Management Science, vol. 25, nº 1, pp. 15-28

Gronroos, G. (2000), "Service Management and Marketing: a customer relationship management approach!, John Wiley & Sons, England

Gupta, AK (1987), "SBU strategies, corporate SBU relations, and SBU effectiveness in strategy implementation", Academy of Management Journal, vol. 30, pp- 477-501.

Hamel, G. (2000), "Liderando la revolución", Ediciones Gestión 2000, Barcelona.

von Hippel, E. (1988), "The sources of innovations", Oxford University Press, Oxford.

Jonash, R. S., Sommerlatte, T. (1999), "The Innovation Premium", Cambridge, MA, Arthur D. Little.

Kim WC, Mauborgne R (2005), "La estrategia del océano azul", Ediciones Granica.

Kohli, AK, Jaworski, JB and Kumar, A (1993), "MARKOR: a measure of market orientation", Journal of Marketing Research, Vol. 30, pp. 467-78.

March, JG. (1991). "Exploration and exploitation in organizational learning", Organization Science, 2(1), pp. 71-87.

Middleton, John, (2003), "The ultimate strategy library", Capstone Publishing Limited

Prahalad, CK and Haml, G. (1990), “The core competences of the corporation”, Harvard Business Review, Vol. 68, pp. 79-91.

Prahaland, CK, Ramaswamy, V. (2003), “El futuro de la competencia: creación conjunta de valor único con los consumidores”, Ediciones Gestión 2000, Barcelona.

Prahaland CK (2005), “The fortune at the botton of the pyramid”, Wharton School Publishing

Porter, M (1998), “Clusters and the new economics of competition”, Harvard Business Review, Vol. 76, pp.77-99

Read, A. (2000), “Determinants of successful organisational innovation: a review of current research”, Journal of Management Practice, 3(1), pp. 95-119

Rodgers, E. M. 1983, “Difussion of Innovation”, Free Press, New York

Roos, J., Roos, G., Edvinsson, L and Dragonetti (1997) “Intellectual Capital. Navigating in the new business landscape”, MacMillan Press, London

Roos, G., von Krogh, G., Roos, J., Fernström, L. (2005), “Strategi – en innforing”, Fagbokforlaget, Bergen

Rothwell, R (1994), “Towards the Fifth-generation innovation process”, Internatoinal Marketing Review, Vol. 11, nº 1, pp. 7-31, MCB University Press

Soderquist, K., Chanaron, JJ & Morwani, J. (1997) “Managing innovation in French Small and Medium-sized enterprises: an empirical study” Benchmarking for quality management and technology, vol 4, nº 4

Tejedor, B. (1998), “Proyecto Logos: Investigación relativa a la capacidad de aprender de las empresas españolas”, Boletín de Estudios Económicos,vol. LIII, Nº 164, pp. 231-249, Asociación de Licenciados Universidad Comercial de Deusto

Tushman, M.L. and O’Reilly, C.A. (1996), “Ambidextrous organization”, California Management Review, Vol. 38, pp. 8-30

Utterback, J. (1996), “Mastering the dynamics of innovation”, Harvard Business School Press

West, A. (1992), Estrategia de Innovación, Fundación Cotec para la Innovación Tecnológica, Madrid.

Yami, S. Gunasekaran, S & Mavondo FT (1999) “Innovation index and its implications on organisational performance: a study of Australian Manufacturing firms” International Journal of Technology Management, vol 17, nº 5, pp 495-503.

Index of Authors

L

M

O

P

R

S

T

V