Towards new challenges for innovative management practices

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Complexity, Innovation and Organizational Form

By Prof Peter M Allen

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Abstract

Complexity is the science of evolution, and in particular that of the emergence and evolution of structures and organizations. A system is simply the apparent structure of elements and linkages that exist at a given time, but a complex system includes in addition to this, underlying diversity and potential that allows a system to transform and adapt itself over time as the environment changes.

Examples will be presented of complex systems models that can help in the design and operation of real production and supply chains. These will be linked to a view of firms in terms of internal practices, which can be seen as resources, which can play a role equivalent to "genes" in biology. The cladistic evolution of auto manufacturing firms will be presented as a co-evolution of different bundles of combinations of practices, with corresponding capabilities for products desired by the market. The presentation will show how it is complexity, and our consequent ignorance, that allows us the freedom that generates the exploratory, creative evolution that lies behind economic development. It is also this necessary ignorance that makes it impossible to state clearly the importance of "case studies" in management research, as opposed to statistical surveys, since the former tells us about what is happening in a particular case, while the latter merely looks for regularities in the data concerning what has occurred. There is no universal "scientific" way to combine a current experience with prior knowledge, and as a consequence, there are necessarily multiple interpretations of the meaning of events. This generation of diversity is the basis of novelty and of innovation, and successful business evolution depends on generating successful operational structures to produce the innovation successfully.

Keywords: Complexity, evolution, organizational form, cladistics, innovation, creativity, freedom, micro-diversity

CULTURAL VISIONS ON PERSONAL COMPETENCIES IN INNOVATION : *a first case of a measured differences between the SMEs' needs and formulations in France, Spain, Germany and Sweden.*

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Abstract: This paper aims to present what the personal competencies in innovation are and how they are built by the innovators. The hypothesis of a cultural variability in the social representations of what an engineer in innovation is, is proposed. We also suppose that the social representations are supplied by the trainings, which question the trainings' logics.
Our methodology is based on the Social and Human Science theories and tools, in particular a content analysis. Our lexicometric study protocol allowed us to analyse qualitatively and quantitatively more than 300 job offers in Europe. We used a categorisation of terms depending on four dimensions of competencies in innovation : interpersonal dimension, personality dimension (i.e. intrapersonal dimension), cognitive dimension and reflexive dimension. The first analysis revealed a fifth dimension that we called "undefined competencies". We call them "undefined" because these competencies are just generative to the occupation. For instance, we can cite the cases where the candidate "must be charismatic" or " must have a high potential". When the Small and Medium Enterprises' require such competencies, how can they evaluate them ? These kind of requirements are especially interesting especially for the researcher in Educational Sciences to improve Engineers trainings in innovation.

Keywords: Innovation; Skill; Job offers; Training; Europe

I. Introduction

What kind of specific and personal competencies support every innovation? This question aims to improve the correlation between the European Engineers Trainings and the SMEs' needs in innovation competencies. In fact the globalisation context has increased a general need for differentiation by innovations for SMEs, of which the first resource may be the young graduates.
On this subject, our interest lies on two Engineering Schools in France belonging to "Institut National Polytechnique de Lorraine".
The first institute, called ENSGSI (Ecole Nationale Supérieure en Génie des Systèmes Industriels) is specialised in innovation engineering and management of innovation with a curriculum based on a systemic approach to knowledge. Its training is based on the personal development of students.
The second Engineering School, called EEIGM (Ecole Européenne d'Ingénieurs en Génie des Matériaux), is specialised in materials engineering. Its vocation is to develop proficiency in several European languages. This training can be considered very traditional as each scientific field is separated from the others and the acculturation is predominantly based on language courses and three semi-annual courses in France, in Sweden, in Spain and in Germany. The students themselves build their cultural experiment without receiving feed-back.
The students do develop competencies in innovation since they are employed in jobs such as R&D engineers, engineers in conception or project managers., All of these are in a European context. Both of these engineering schools train students to be innovative. In the frame of our survey, we were asked by those engineering schools to define what the personal competencies in innovation are. Answering to this question demands at first to know how the industrials and engineers express the personal competencies that they request.

If a large part of European industrial experts and European recruiters agrees to recognise that the personal competencies in innovation do exist, they experience difficulties in defining and inevitably in expressing them. That does clearly evident that the personal competencies in innovation are essential but difficult to encircle for building a learning within specific engineer training.
In this paper we address this question with empirical investigations based on :

-The results of an expert questionnaire defining and classifying what competencies in innovation are (BARY, 2006)

-A lexicometric analysis from more than 300 job offers issued from four European countries and lighting different social representations and the first case of national differences between the SMEs'needs and their formulation.

II. Defining the personal competencies in innovation

To try to definite what the personal competencies in innovation could be, we asked 27 experts in the field of innovation to complete an expert questionnaire (BARY, 2006). The population-surveyed that we chose was composed of academics, engineers and industrials. The employed methodology laid on qualitative metrology (REGNIER, 1989). We proposed to them 46 no-classified items to which they had to attribute a coloured notation corresponding to their adhesion's gradation. This method is relevant because our aim was to elaborate the most exhaustive list, even if there were several levels of logical reasoning presented. The personal competencies that we presented to the experts belong to four dimensions sustaining every competency and knowledge: the personality dimension, the interpersonal dimension, the cognitive dimension and the reflexive one.
Based on our propositions, the experts classified the items depending on what seems to be the most important for an engineer in innovation. Here are the findings we collected:

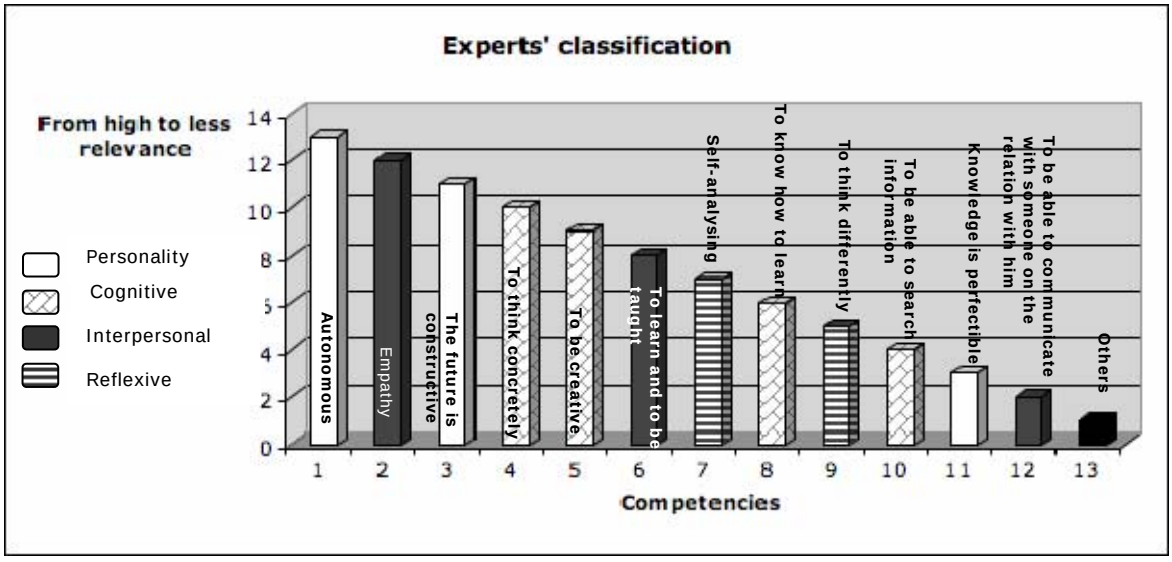


Figure 1

We classified the experts' answers to determinate what could be the most important personal competencies to be able to innovate. Thus, after a compilation of theirs answers depending on each dimension, it clearly appears that personal competencies based on the personality and cognitive dimensions are requested and strongly valorised by the experts. Since our aim is to encircle a core of personal competencies in innovation on which our population-surveyed can agree, we compared the precedent results to the SMEs' speech thanks to an analysis of job offers. We measured by an indicator of the formulation funded on a compilation of four countries' job offers : France, Sweden, Germany and Spain.

III. Analysing the SMEs' speech: different cultural visions of competencies

We studied by an analysis of content (BARDIN, 2003) more than 1000 job offers for engineers in innovation during a year and a half in the European labour market. We limited our choice to 300 homogeneous offers depended on the Labour Market flow.

The population-surveyed: European job offers 2005-2006
(sources : SMEs' websites, National and Private Placement centres)

	R&D Engineers		Conception Engineers		Quality Engineers		Total	
France	31	33%	33	33%	31	33%	**95**	100%
Germany	27	33%	28	33%	28	33%	**83**	100%
Spain	25	33%	22	33%	24	33%	**71**	100%
Sweden	20	33%	15	33%	16	33%	**51**	100%
Total	**103**		**98**		**99**		**300**	**100%**

Figure 2

In order to limit the problems due to translation, we had native bilingual engineers make the translation of the offers. We stabilised this translated vocabulary by codification and categorisation. In every offer, we took into account the order of terms, the relations between terms (recurrences) and we linked them to the findings issued from the experts' questionnaire. In this paper, we chose to focus on the case of R&D engineers, because the weight of the competencies in innovation is as equally as the scientific ones.

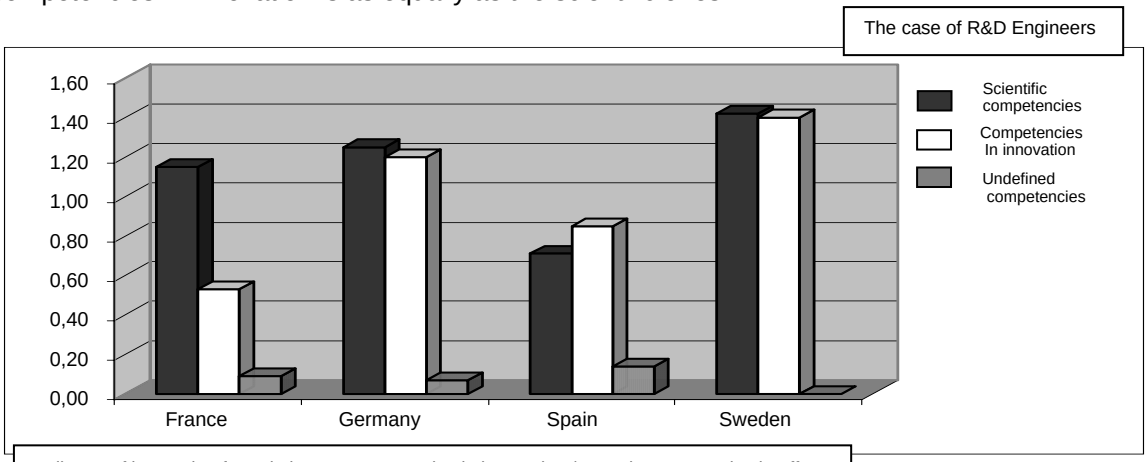


Figure 3

In our investigations, we noticed a fifth dimension required in France, in Spain, and in Germany, but not in Sweden: We called this dimension "the undefined competencies". In all offers except Swedish ones, the candidates must be "charismatic", "must have a high potential", "must be motivated", "must be rigorous", "must be active" and/or "must be dynamic"…. Those seem to be determinant in being recruited because it corresponds to one specific vision of innovation.

We have detailed for each country the required personal competencies in innovation including the undefined-competencies:

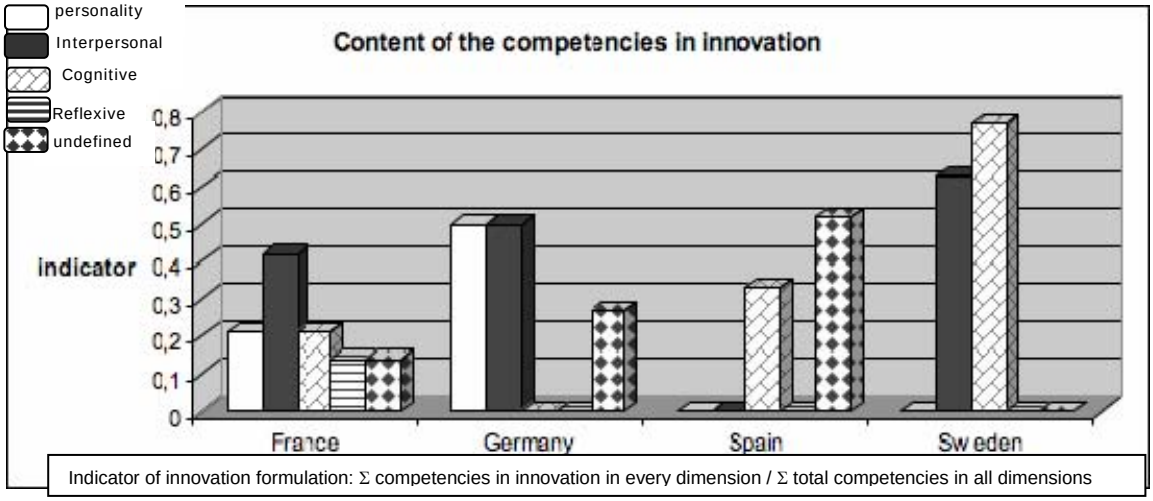
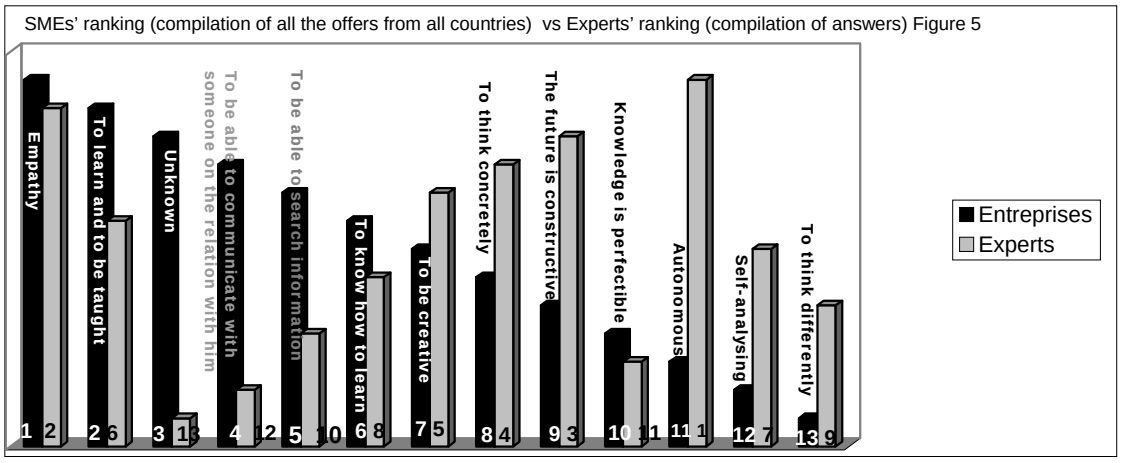


Figure 4

The personal competencies in innovation for an R&D engineer were weighted different depending on the country. The required study level was an engineering master's degree and the required experience for the candidates was between one and five years. Thus we can consider our population as homogeneous. The major hypothesis that we propose to explain such differences is a cultural representation of what an engineer in innovation should be. For considerations of space we are unable to detail our survey about the culture concerned and its training systems.



We also notice that there is a complete distortion between the vision of the experts and the SMEs. The interpersonal dimension clearly appears as a priority in the SMEs ' vision. The common core of competencies in innovation could be the cognitive dimension and the biggest distortion the fifth dimension composed by the unknown competencies.

IV. Perspectives and conclusion

Based on the techniques of explicitation, interviewing European engineers, we will cross our results with the concrete occupations, Thus, our research perspectives from these findings will be used to build a skills framework for the students in the engineering schools in innovation.

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Software Agents and ebXML Specifications for a Business Web Service

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Abstract: In this paper, a Business Web service based on the electronic business XML (ebXML) specifications is proposed. It makes use of software agents which can be used for business intelligence, in discovering partners, shopping behavior patterns or service providing patterns and react to pattern change. They can analyze requests and determine how to fit it with a Web service. The proposed Web service permits to promote the interoperability of the business process and could be very helpful to support the B2B life cycle transaction.

Keywords: ebXML, Web service, B2B eCommerce, Agents, Interoperability.

I. Introduction and background

In order to support business collaborations, many standards and information technologies have been proposed. We give a brief overview of some well-known business standards. Historically, at the end of the years 1980, EDI, the Electronic Data Interchange, one of the pillars of e-business, was a standard communication tool between companies. The Electronic Data Interchange is structured data exchanges between partners respecting a standard format. EDIFACT (Electronic Data Interchanges for Administration Commerce and Transport) is a ISO 9735 norm used for EDI. It is a technology maintained and coordinated by the center CEFACT under United Nations aegis[1]. In the middle of the years 1990, XML[2] appears, and with Internet the passage from EDIFACT syntax to XML meta-language becomes a need. A combination XML-EDI based on Internet and XML meta-language has been proposed in order to integrate EDI among communication tools between companies and essentially to open it on new partners on the Web. With the end of 1990, a proliferation of projects using XML was noted. Consequently, standardization was essential to meet the great need of coherence, compatibility, unification and interoperability.

In order to standardize B2B eCommerce (B2B eCommerce is data exchanges inter-enterprises called business- to-business eCommerce), several initiatives have been born. Among them, we mention RosettaNet[3] and ebXML[4] . RosettaNet is a standard proposed in 1998 to formalize in XML all the necessary elements for automating Web services using production and distribution methods. RosettaNet is proposed mainly for Data processing electronic and semiconductors sectors. However, a certain concepts can be applied to the electronic commerce, which explains the link between RosettaNet and ebXML. The electronic business XML (ebXML) framework has been proposed by the United Nations Centre for Trade Facilitation and Electronic Commerce (UN/CEFACT) and the Advancement of Structured Information Standards (OASIS)[5] organizations in 2001. The ebXML provides a complete framework for setting up B2B collaborations. It is a set of documents, with several prototype completed, enabling businesses of any size to do business electronically with anyone else.

[1] UN/CEFACT, United Nations Centre for Trade Facilitation and electronic Business, http://www.uncefact.org

[2] XML,http://www.xml.org

[3] RosettaNet, http://www.rosettanet.org/RosettaNet

[4] ebXML, http://www.ebXML.org

[5] OASIS, Organization for the Advancement of Structured Information Standards, http://www.oasis-open.org

On the other hand, the Web service is a new technology which can be very useful for promoting the interoperability of the business process. A Web service is defined by W3C[1] as "*a software system designed to support interoperable machine-to-machine interaction over a network. It has an interface described in a machine-processable format (specifically WSDL). Other systems interact with the Web service in a manner prescribed by its description using SOAP-messages, typically conveyed using HTTP with an XML serialization in conjunction with other Web-related standards*". In addition, a Web service is viewed by W3C as "*an abstract notion that must be implemented by a concrete agent. The agent is the concrete entity (a piece of software) that sends and receives messages, while the service is the abstract set of functionality that is provided*".

Motivated by both ebXML and Web services advantages, we suggest a business Web service for B2B eCommerce. In addition, the proposed Web service makes use of software agents. The utilization of agents is justified by their capabilities to discover, combine and execute dynamically a business process. The agents can facilitate the communication between the system and the users. The ebXML specifications can be very helpful to support the B2B life cycle transaction.
Several works can be related to this trend of research. Among them, we cite the contribution of (Hofreiter and Huemer, 2005) which extends UMM (UML Meta Model). In (Wu et al, 2003) the authors use DAML-S for Web services descriptions. The agents are used by (Gibbins et al, 2003) for a semantic Web service and by (Boughaci and Drias, 2005) to solve bid evaluation. The central foundation of our work is connecting ebXML, Web service and software agents to conceive a business Web service for the B2B eCommerce.
The rest of the paper is organized as follows: Section 2 proposes the novel business Web service and gives some implementation details. Section 3 concludes the work.

II. The proposed Web service

The proposed Web service uses ebXML specifications and software agents. An agent is a software entity permitting to achieve tasks. It may be autonomous, reactive and able to communicate with the knowledge-based systems. Agents can be used for business intelligence, in discovering partners, shopping behavior patterns or service providing patterns and react to pattern change. In addition, agents can play different roles to accomplish business activities and accommodate change in environments.

The business Web service enables the storing and sharing information between parties to allow e-business collaboration. It stores BPSS (the Business Process Specifications Schema), CPP (the Collaboration Protocol Profile), CPA (the Collaboration Protocol Agreement), UML (The Unified Modeling Language) models and so on which may be needed to support any e-business collaboration. The business Web service (represented by provider agents) is an application that provides services for other client's applications (represented by seeker agents) via the Web. The communication between clients and server of a Web service is realized using XML-based messages.

1. The Proposed Web Service Architecture

The proposed system depicted on Figure 1 is characterized by the following:

- The Provider Agents which represent the Web service: it includes the ebXML registry and repository containing all the necessary information about partners and the business process.
- The ebXML registry permits to store and manage a wide range of electronic trading parameters. The ebXML registry is the registry of B2B, while the Universal Description, Discovery and Integration, UDDI (Bellwood et al, 2003) is the registry for Web services.
- The Seeker Agents which request the Web services.
- The ebXML BPSS and CPP which give it the functionality of the Web Services Descriptions Language, WSDL (Christensen et al, 2001) plus error handling and failure scenarios.

[1] Web Services Architecture, W3C Working Draft 8 August 2003, http://www.w3.org/TR/2003/WD-ws-arch-20030808/

- The service description and semantics are realized by provider and seeker agents according to ebXML Specifications.

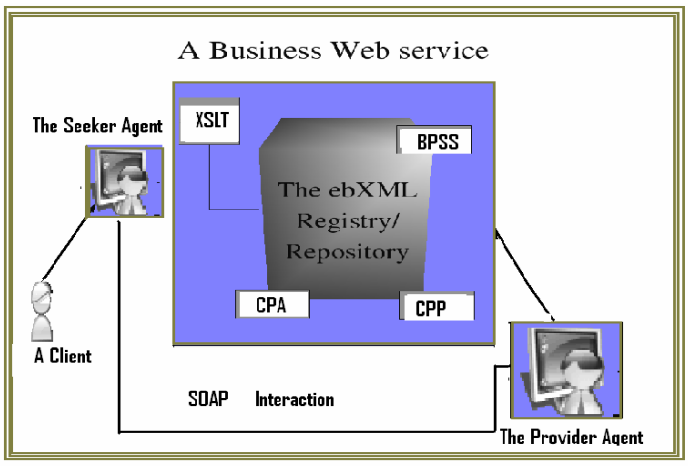

Figure 1. The Business Web Service Architecture

2. Implementation Details

To implement the proposed system on machine, we suggest using JAVA programming language (see, Java Web Site), starting with JDK1.4.0 which interpret well with XML (Javax.xml.* packages for processing XML document for example).

Tools

To implement such application, we need some tools and standards as:

- XML: is used to well structure Data-exchange and describing business documents (CPP, CPA, etc,) and supported by most software and databases.
- SOAP (Simple Object Access Protocol) (Box et al, 2001): is used to exchange XML structured information on Internet.
- Registry/repository where Web service providers can put their services and users can search for desired business Web service.
- JAVA[1] Servlet using the JAVA API for XML messaging to implement the conversion document.
- Oracle[2] as database and Apache Web server. We precise that Oracle has implemented support for XML and the Oracle XML Developer's Kit (XDK) can provide components, utilities and interfaces to take advantage of XML technology in database applications.
- HTTP (Hyper Text Transfer Protocol) for supporting communication between a client and a server. HTTPS is the secure variation of HTTP. It uses Secure Socket Layers (SSL) to set up an encrypted connection. The security level of XML documents can be ensured by using XML encryption and digital signature.
- JAVA Server Pages (JSP) is used for designing the Web Interface.
- The XML generation document is based upon XSLT styles sheets created by an administrator and stored in the registry. The XML parser for JAVA includes an integrated XSL transformation (XSLT) processor for transforming XML data using XSL stylesheets. With XSLT processor, we can transform XML document from XML to XML, HTML or any other text-based format.

The Web Service Implementation

The proposed Business Web service application is depicted on Figure 2. The role of the conversion servlet is processing the conversion request and sends the converted document in the desired format back to the client. First of all, the XML document to be converted is included as SOAP attachment of a SOAP conversion request. The latter is related to the requirement specified in a BPSS document stored on the Web server. The conversion servlet processes the

[1] Java, http://java.sun.com/

[2] Oracle, http.//www.Oracle.com/xml

SOAP conversion request and validates them, then queries the repository/registry in order to realize the conversion using the styles sheets stored in the registry. After that, the ensuring XML document is sent back to the requesting application as a SOAP response. As shown on Figure 2, the client can prepare its XSLT style sheets and formatted it using the mapping functions provided by the Web service. He can also upload it into the registry. The discovery servlet process the SOAP searching request and queries the registry/repository in order to find the appropriate XML business information. The search strategy uses tables of indexes containing key words, utilities (or weight that means a number of frequency of apparition of the keyword in the document) and URL to the XML documents (Content). The ensuring XML document is sent back to the requesting client as a SOAP response.

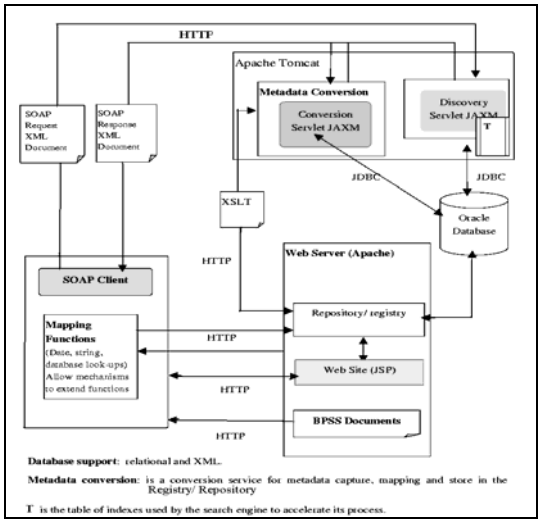

Figure 2. The Business Web Service Application

III. Conclusion and future works

In this work, we have proposed to use ebXML specifications combined with the agents to implement a business Web service to support B2B eCommerce. The proposed Web service merging the ebXML and Web service technologies is an application represented by provider agents for providing services via the Web for other client's application represented by seeker agents. The communication between agents is realized using XML-based message according to ebXML specifications. As future work, we plan to study the impact of mobile agents on our business Web service. It looks important to use ontology for providing additional vocabulary along with a formal semantics.

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Creative routines embedded in Communities of Practice

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Abstract: The concept of routines is helpful to understand the process how productive knowledge is stored in the firm's organizational memory. It also provides the means to analyse how knowledge is integrated into action. The ability of a firm to process information and create knowledge seems to be one of the highest level routines in firms. This process can be seen as a set of routines which are available to acquire, create and exploit knowledge, and together form one Organizational Capability. This paper presents empirical research about how some advanced firms are building this organizational capability. Results will show that firms are still devoting efforts to information acquisition, whereas other routines for knowledge creation and exploitation do not achieve the category of routines.

Keywords: Knowledge management, routines, communities of practice, dynamic organizational capability.

I. Introduction

It was twenty four years ago that Nelson and Winter (1982) proposed routines as the unit of analysis for an evolutionary theory of change. The concept has been widely used in economics and business literature, but many ambiguities and interpretations still remain regarding the concept. (Jones and Craven, 2001)

On the other hand, literature concerning Organizational Knowledge Management is coming closer to the concept of routines when talking about a company's capability to process knowledge. (Nonaka and Toyama, 2002) have used the concept of creative routines to define the time and space where knowledge is processed and created. Seely and Dugid (2000) have successfully promoted the concept of Communities of Practice (CoP) as the unit of analysis to understand knowledge creation processes. This unit of analysis is situated between the concept of whole and individual organization.

Taking into account the apparent conceptual proximity of these ideas, we want to explore the hypothesis that most innovative companies establish creative routines in order to respectively process and create information and knowledge. These creative routines follow complex interactions between their members and CoPs provide the contextual environment for such interactions.

To have a clear picture of the different routines we have established three categories following the concepts of high and zero level routines from Winter (2002). The zero level routines are Operational Routines, for us, which explain activities that are concerned with maintaining and exploiting current business. Improvement Routines are those that are concerned with improving Operation Routines, whereas Creative routines are those concerned with processing information and creating knowledge.

To test the hypothesis, we have conducted empirical research in 85 small and medium sized businesses in the Basque Country (Spain). 21 of these firms were directly interviewed, whereas 64 responded to a web-mail based questionnaire. Results will show that firms acknowledge the importance of information – knowledge processing capabilities, but few are establishing concrete routines for such activities. Most firms use existing activities to process information and create knowledge.

II. Routines and Dynamic Capabilities: The Starting Point

In his literature review about the concept of routines, Becker (2000) states that routines mainly refers to the path of a collective recurrent activity (observable and not observable) as opposed to habits that are paths of individual recurrent activity.

Becker finds that Winter's (1964) first definition regarding repetitive patterns of activity has been subjected to many interpretations when trying to capture the idea of behavioural models. Some interpretations are based on actions (Egidi, 1996) Cohen et al. (1996), others on activities(Winter (1990), Dosi, Nelson, Winter (2000)), or interactions Dosi, Teece and Winter (1992), Teece y Pisano (1994) or behaviour Nelson y Winter (1982) and a large group of authors. In this respect, we can also come across some semantic problems in the use of words by different disciplines. Action and activity can be synonymous, whereas interaction clearly states a collective action. Behaviour means something that is directly observable, but apparently repetitive patterns of activity can be non observable.

According to Becker (2000), characteristics to recognise a routine are as follows:

- Routines are patterns of interaction
- Routines are persistent and repetitive
- Routines have a collective nature
- Routines are non-deliberative and self actuating
- Routines are context-dependent and specific
- Routines have path dependency

Winter defines ordinary or "zero-level" capabilities as those that permit a firm to "make a living" in the short term, and define dynamic capabilities as those operated to extend, modify or create ordinary capabilities. Collis (1994) suggests a hierarchy of high order capabilities. Following these thoughts, Winter (2000) founds the concept of organizational capability on the broader concept of organizational routine as : An organizational capability is a high level routine (or collection of routines) that together with its implementing input flows, confers upon an organization's management a set of decisions options for producing significant outputs of a particular type.

This organizational capability like other dynamic capabilities suggests change and contrasts with ordinary capabilities. Collis (1994) suggest that dynamics capabilities govern the rate of change of ordinary capabilities. But there is no guarantee that this organizational capability exists because is possible to change without having such capability. Many firms respond to ad-hoc problems as soon as the problems arise and are visible, by being merely rational and passive. (Winter, 2000). In any case, there are many forms of reaction between simple and pure improvisation on a close procedure.

The point is that according to Winter (2000) we want to know if firms are investing in building organizational capabilities as a set of routines, in the sense that some personnel are committed to roles of change. If change is continuously destroying internal capabilities, then high order capabilities must be deliberately constructed within firms to maintain, create and recreate new capabilities.

III. Information processing and knowledge creation as Organizational Dynamic Capabilities

The fifth generation innovation process according to Rothwell (1994) is based on interaction between different partners including external partners, such as customers and suppliers. Lundvall and Borras (1997) point out the change from an innovation paradigm based on discovery and invention, to another one based on learning and interactions. Von Hippel (1998) stresses the importance of external knowledge for innovation.

The need for recognizing changes, the ability to react on time and the use of resources to rapidly innovate in collaboration with other partners seems to be a very distinctive organizational capability for competitiveness. To be able to recognize changes, latent markets, low noise

signals of technological change, and to rapidly react and act, is mainly a process involving acquiring information and knowledge creation. Zhara and George (2002) conceptualize this ability as "absorptive capacity". This absorptive capacity is a dynamic capability that evolves over time and it is more focussed on the knowledge processes than on knowledge stocks. This absorptive capacity will be dependent not only of past existing knowledge but on the ability of the firm to process information, learn and create new knowledge.

Most innovation indicators concentrate on inputs regarding investment in the knowledge stock but little attention it is given to the organizational capacity to process information and create knowledge. Knowledge creation, is a set of routines, including information acquisition, internal information gathering, product development, learning processes, information dissemination, etc, that defines the ability of the firm as a whole to create knowledge. It is the information acquisition – knowledge creation capacity of a firm based on different routines in the sense defined above. Teece et al (1997) argue that skills and routines may offer competitive advantages only if it is able to recognize changes, and reconfigure its basic assets and processes continuously. As the environment opens and closes windows of opportunities very quickly, high order capabilities become essential for competitiveness.

IV. Creative Routines and Communities of Practice

We will always have the possibility of establishing procedures for information processing and knowledge creation but with many authors, Nonaka and Toyama (2002) Snoweden (2002), Stacey (2001), Sveiby (2001), we think that knowledge creation is a dialectic process of complex interactions. Within and between organizations, people involve themselves in a dialectic process to synthesize information and create knowledge. Knowledge from this point of view is seen as a relating activity. Seely and Duguid (2000) see this relating activity as natural to communities of practice where people share common understanding due to common practice.

Many authors express the space – time idea for interactions to create knowledge. These entities are appropriate environments (Ba in the words of Nonaka, Cynefin in the words of Snowden) to blend and combine concepts, the whole and the parts, order and chaos, where the synthesis is achieved not as the fruit of consensus but as the fruit of creation. It is not one optimization process; it is not a process of problem resolution but a process of problem definition.

Hagel and Singer (1999) believe that firms need "to unpack" the contradictions in organizations and choose between contradictory views, but the view we are following is that capacities and competences can be changed in order to solve these paradoxes. If the environment offers new perspectives, organizations can offer new answers. The process of creation is an appreciative process of recognising, analysing and responding to new circumstances. The environment influences the vision and action, where the opposite is also true. The interdependent nature of environment and organization is well recognised by the evolutionary economy whereas the schools that view organizations as static structures hardly digest these ideas.

The question is that recognising changes is as important as doing something with them. From this perspective, knowledge is close to action as it is the place where synthesis happens. Sveiby (2001) and Nonaka and Takeuchi (1995) define the process of interactions as multiple, transcending the individual level. It is not learning but knowledge creation.

But the nature of these interactions is complex and unpredictable. It is impossible to codify or even map all the situations. It is not personal cognition but something manifested in action. In this sense the concept of communities of practice, expressed by Seely and Duguid (2000) provide a powerful concept to handle these complex interactions of knowledge creation. CoPs seems to provide the energy, the environment, and the experience to embed information and knowledge creation processes. Common practice (action) is the ingredient that allows Cop's member to gain common understanding and produce action.

V. The Research

The main hypotheses to be tested in the research and the subsequent research questions are:

H1. Do advanced firms present organizational routines for information processing and knowledge creation?
H2. Do these sets of routines form a Dynamic Capability based on Knowledge Acquisition, Knowledge Production, and Knowledge Exploitation?
Q1. How are these organizational routines embedded in the organizational chart?
Q2. Do these organizational forms resemble the concept of Communities of Practice?

Model: Following Nonaka and Toyama (2002) and Seely and Duguid (2000) we can see the firm as a community of communities throughout organizational life. Following the hypothesis of the research, our model presents the idea of a basic Dynamic Capability based on three Communities of Practice, one for Acquisition of Knowledge, one for Creation of Knowledge and one for Exploitation of Knowledge.

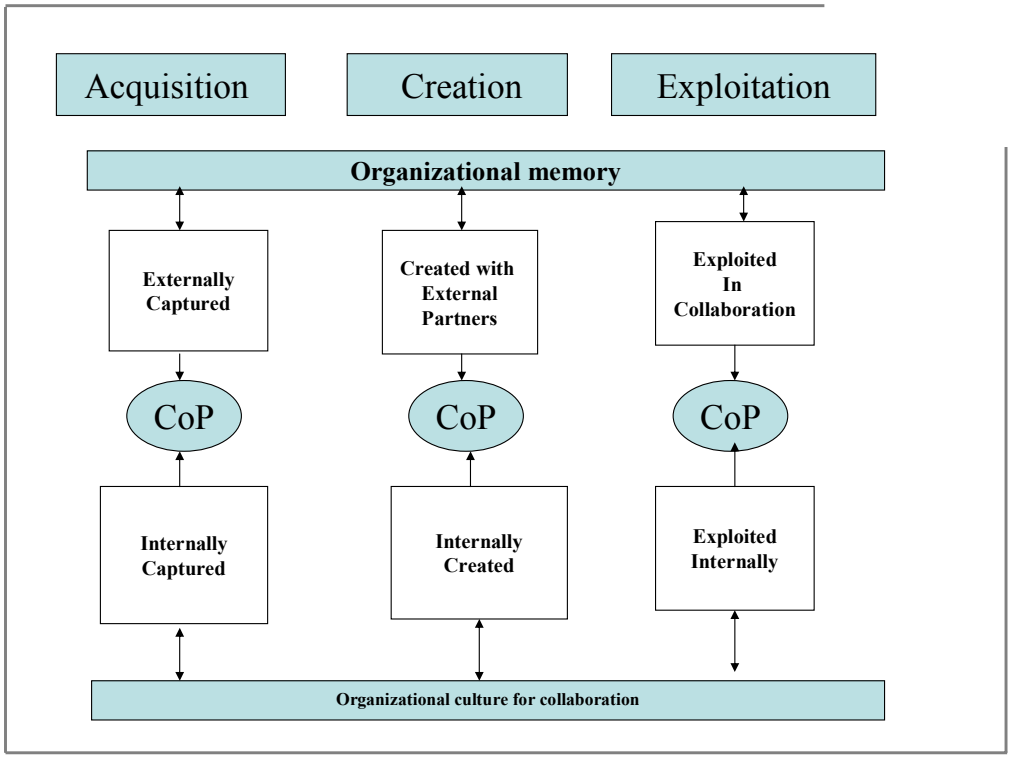

Figure 1. Acquisition, creation and exploitation model

Sample: Firms were chosen following three different criteria to reach Firms Advanced in Management (Prizes, business school case studies, excellence in performing the scheme of the European Foundation for Quality Management)

From a universe of more than 300 firms, finally research has been conducted in 85 firms. 21 of them were directly interviewed and the rest were contacted using e-mail based questionnaires.

VI. Results

Results show that firms start creating routines for information processing and knowledge creation, but are still far from having a set of systematic routines that can be described as organizational capability.

Firms invest heavily in acquiring information, but after this acquisition it is not clear how the information is processed. Few groups seem to have the characteristics of the Communities of Practice for Acquisition and Exploitation. In the creation process some forms of CoPs appear around the new product development processes.

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Continuous Improvement Processes in Manufacturing Enterprises as an Enabler of Process Innovation

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Abstract: This paper focuses on the concept of continuous improvement processes (CIP) as a type of non-technological innovation. In particular, the diffusion of this organisational concept among German manufacturing firms will be analysed. The analysis is based on data from the *German Manufacturing Survey 2006* which is carried out every two years by Fraunhofer ISI. The underlying sample comprises data of 1,663 firms. Besides the diffusion of this concept in different sectors and different firm sizes, effects of continuous improvement on the process innovation capability of enterprises will also be analysed. Furthermore, additional application potentials of continuous improvement processes, respectively their implementation barriers will be identified.

Keywords: continuous improvement processes, non-technological innovation, process innovation

I. Introduction

The concept of innovation is often reduced to the creation of new products or new technological solutions (Kirner et al. 2006). However, following a wider understanding of innovation, the ability to innovate cannot be determined without its economic context, as innovation is not an end in itself but a means to reach, maintain and increase competitiveness and economic success (Schumpeter 1931; Tidd et al. 2005; Vahs/Burmester 2002). Thus, only economic success distinguishes an innovation from an invention. Besides new products, also new services, production methods, markets or new sources of supply, new types of organisation structures can be regarded as innovations if they contribute to increase competitiveness and economic success (Schumpeter 1961; Tidd et al. 2005; Kirner 2006). In compliance with this broad approach, innovations include non-technological aspects like service and organisational innovations as well as technological dimensions such as new products or manufacturing processes. Since the publication of the Lean-Production-Study by Womack et al. (1990), the impact of non-technological innovations such as new organisational concepts has been increasingly acknowledged. New organisational concepts can contribute to increase efficiency and competitiveness.

II. The management concept of "Continuous Improvement Process" (CIP)

The aim of CIP as a management concept is to improve the quality of both the products and the technical and organisational processes of an enterprise in small yet continuous steps. Another central aspect of CIP is the direct individual or team-based participation of employees in the improvement process. Ideally, employees are not only involved in the identification of possible improvement areas but also in the implementation process of their own proposals and suggestions (Bösenberg/Metzen 1993; Witt/Witt 2006). Thus, an organisational culture that encourages and promotes the employees' contribution to improvement of the work process is essential. CIP as a concept has its origins in the Japanese management idea of Lean Production, widely known as "Kaizen". Originally, CIP was mainly deployed in the manufacturing and assembly process of large automotive manufacturers with large batch sizes. It can be now assumed that this concept has found its way to other sectors as well as to small and medium sized enterprises (SMEs) with small and medium batch sizes, since not only large enterprises are able to benefit from CIP. SMEs can also enhance their competitiveness by constantly improving the quality of their work processes and products. However, reliable data regarding the use of CIP in industry have been scarce in the past. This paper addresses this shortcoming and will empirically analyse the diffusion and effects of CIP in the manufacturing industry.

In this context, the following questions will be addressed:

- Which is the degree of diffusion of CIP in large enterprises and in SMEs in the German manufacturing industry?
- Do sector-specific differences exist in the implementation of CIP?
- Can unexplored potentials of CIP be identified?
- What are the effects of CIP on labour productivity, quality and flexibility?

III. Diffusion of CIP in the German manufacturing industry

The analysis or firm level data shows that currently nearly three quarters (72 percent) of the surveyed enterprises have implemented CIP. However, breaking down the firms by their manufactured batch sizes, it becomes apparent that most users of CIP are still enterprises with large batch sizes (78 percent). Enterprises producing in single, small or medium bath size use CIP to a lesser extent (70 percent). This may be due to economies of scale, leading to greater efficiency through the improvement of individual work steps in large enterprises. In contrast to batch size, the complexity of the manufactured goods does not seem to have any influence on the use of CIP.

CIP are particularly widely used in high-tech and advanced technological sectors such as in the electrical industry, medical engineering, or optics and automotive and suppliers industry. Furthermore, CIP is clearly more often implemented in large firms with more than 250 employees than in SMEs with less than 250 employees. Almost 90 percent of large enterprises of the manufacturing industry have already implemented CIP, compared to only about two thirds of SMEs. This greater diffusion among large enterprises can be observed in nearly all sectors. The difference in the use of CIP between large enterprises and SMEs is most striking in the automotive and suppliers industry, where CIP are used by all large enterprises but only by 72 percent of SMEs. It is thus obvious that CIP is still traditionally mainly anchored in large enterprises of the automotive industry. Although SMEs of the food, textile and chemical industries as well as the machinery industry have caught up on the application of CIP, the most relevant implementation potential can be presumed for this group.

In addition, significant differences can be observed regarding the dynamics of the implementation of CIP in large firms and SMEs. Nearly 25 percent of SMEs have introduced CIP only in the last three years compared to only 10 percent of large enterprises. This might reflect the perceived need of SMEs to catch up on the use of CIP. Should this high prevailing dynamics of implementation be maintained, it can be expected that SMEs and large firms will soon have implemented CIP to a comparable degree.

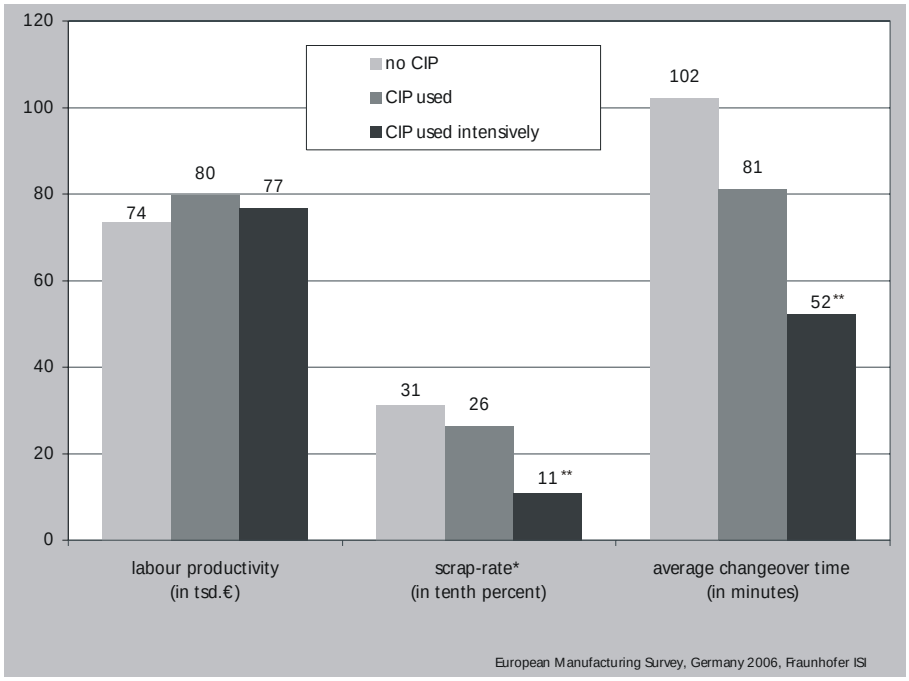
IV. Intensity of CIP-implementation

The implementation of CIP in firms of the dataset varies stronger if considering the intensity of use of this concept within the enterprise. Organisation concepts such as CIP can be implemented to various extents, ranging from mere pilot implementation to wide internal diffusion. In order to estimate the extent of use of CIP, surveyed enterprises were asked to estimate whether CIP has been implemented and diffused within the firm to a low, medium or high degree. Almost 40 percent of large enterprises with 250 or more employees have stated to have exploited the full potential of CIP. Interestingly, these are only 45 percent of all those firms which declare to have introduced CIP at all. An even more striking relativisation in the proportion of CIP users can be observed in case of SMEs. Only 18 percent of SMEs have stated to have exploited the full potential of CIP. This equals only one fourth of SMEs using CIP at all. Thus, a considerable gap exists between the proportion of enterprises using CIP and those which have indeed implemented CIP to its full internal potential. This is particularly the case in SMEs.

V. Effects of the implementation of CIP

In the light of an assumed unexploited potential of CIP implementation in SMEs in the German manufacturing industry, possible economic effects of a wider exploitation might be of interest. Such an analysis is not without difficulty as several factors such as firm size or batch size do influence both the use of CIP and also the value of indicators like labour productivity, process quality and process flexibility. For this reason, the effects of CIP are analysed for a specific type of enterprises with homogenous production conditions: small and medium sized automotive manufacturers and suppliers with less than 250 employees, producing in large batch sizes. In the underlying database, 91 enterprises of this type could be identified. 91 percent of them have introduced CIP and 29 percent of these firms have stated to exploit the full internal potential of CIP. In order to analyse possible effects of CIP, enterprises not using CIP will be compared at first to those which have introduced CIP and in a second step with those using CIP intensively by exploiting the full potential of CIP within their enterprise. Figure 1 shows the results of this analysis.

Figure 1: Effects of CIP for SMEs in the automotive and supplier sector with large batch sizes



* Defined as average percentage of products that have to be scrapped or reworked

** Comparision of means related to both comparision groups; significance level p<0.05

The findings can be summarised as follows:

- The labour productivity does not differ statistically significantly among the three types of CIP-users. The average labour productivity per year varies only between 75,000 to 80,000 euro per employee, which does not indicate any big difference between CIP-users and non-users.

- The lowest scrap-rate of 1.1 percent, defined as the average percentage of products in need of reworking or scrapping, is to be found in firms which use CIP intensively and have implemented it to its full potential. This result is statistically significantly lower than the scrap-rate in enterprises which do not use CIP to its full potential (2.6 percent) or have not implemented CIP yet (3.1 percent).

- The medium changeover time for machinery as an indicator for the flexibility of production systems is again statistically significantly shorter in enterprises which are using CIP

intensively (52 minutes) compared to firms which have introduced CIP but do not exploit its full potential (81 minutes) or compared to non-users (102 minutes).

These results thus show two different aspects: on the one hand, labour productivity might not necessarily be the appropriate measure to assess the effects of organisational respectively non-technological process innovations. On the other hand, organisational measures can aim at the improvement of performance indicators such as process quality and product flexibility without implying negative effects on labour productivity. This could be shown for the analysed type of enterprises (SMEs in the automotive and suppliers sector with large batch sizes) exploiting CIP to its full extent. These firms seem to be able to improve their competitiveness through higher quality and greater variability and flexibility without suffering any losses regarding productivity.

The analysis also shows that it might not be sufficient to differentiate only between users and non-users of organisational concepts when assessing of performance effects of these measures in enterprises. Rather, it is important to consider the intensity of implementation as well. Comparing just CIP-users to non-users would not have led to any significant performance differences in this case. The performance effects have only become transparent in case of intensive use.

VI. Conclusion

The presented empirical analysis of the use of CIP has revealed that this organisational concept is already widely implemented in the German manufacturing industry. Primary CIP-users are large enterprises with more than 250 employees as well as producers of large batch sizes. Unexploited potentials of use are mainly found among SMEs, although these are catching up which is indicated by the prevailing high dynamics of implementation. The overall relatively high diffusion of this concept in industry seems to be justified. On the example of a selected type of enterprises it could be shown that firms using CIP and exploiting its full internal potential are achieving better product quality as well as higher flexibility without any loss of their productivity. As CIP aim at process innovation as well as improvements of competitiveness and business performance, this concept is a vital part of a holistic innovation management approach, which focuses not only on the development of new products and services but also on the improvement of technological and non-technological processes and workflows within the firm.

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The relevance of product related services in industry

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Abstract: Services are playing an increasingly important role in advanced economies. New products alone often do not satisfy the needs of customers, they require systematic problem solutions which include a bundle of products and product related services. Many manufacturing enterprises have recognised this demand for complete solutions and are already offering their customers a range of different product related services. Hereby, a wide variety of different services can be distinguished. Besides traditional services such as training or maintenance, manufacturing firms can also offer more advanced services such as financing services or operating models. Based on firm level data from the *European Manufacturing Survey 2006* for Germany and Spain, this paper explores the empirical relevance of product related services for manufacturing enterprises of different sizes in different sectors. On the one hand it will be empirically analysed which types of services manufaturing firms offer to their customers, on the other hand it will be shown that product related services significantly contribute to the sales of manufacturing firms. Services will be shown to be particularly important for manufacturer of complex products and single unit or small batch size manufacturers.

Keywords: Product related services, service strategy, manufacturing firms, sales with services

I. Introduction

Services contribute significantly to the GDP of modern economies. In most industrialised countries, the service sector has meanwhile overtaken the manufacturing sector in terms of economic relevance and employment. But services are not only generated and offered by service firms. Manufacturing firms also provide a wide range of different services to their customers. Today, many manufacturing firms supplement their product portfolio with product accompanying services in order to offer custormers a more complete problem solution (Lay&Jung-Erceg 2002). Regarding the competitiveness of the firm, product related services can serve as a differenciating characteristic which distinguishes firms within the same market. Manufacturing firms can therefore consciously pursue a strong service strategy in order to achieve competitive advantage. By integrating products and services, firms are able to offer their customers unique problem solutions.

Although there is little doubt about the increasing importance of services for manufacturing firms, empirical data on product related services and especially on their contribution to firm´s market success are rare, mostly because non technological innovations are difficult to assess (Damanpour et al. 1989, Miles 2004). Measuring the impact of services on the innovativeness and performance of firms seems rather difficult compared to technical product innovations. Existing indicators and metrics often do not reflect the specific aspects of service innovation adequatly (Kanerva et al. 2006, Hipp&Grupp 2005). This paper addresses this prevailing lack of empirical evidence of the importance of services and aims at analysing services in the manufacturing sector. The presented analysis is based on data of 1663 manufaturing firms in Germany and 147 manufacturing firms in Spain.[1]

[1] The *European Manufacturing Survey* is a regular written survey coordinated by the Fraunhofer Institute of Systems and Innovation Research (ISI) every two years. The survey addresses a random sample of firms with 20 and more employees in the manufacturing sector in Germany

II. Product related services in manufacturing firms

Manufacturing firms can offer a wide range of different services to their customers. Some of the services are more traditional, some are rather advanced. Project planning/ consulting, technical documentation, assembly or training are services which are traditionally offered by some manufacturing enterprises accompanying their products. Leasing, renting and financing services, software development or build-operate-own models however are more advanced forms of services which are not yet widely offered or used (Statistisches Bundesamt 2004). In order to be able to offer such advanced services, firms need enhanced competencies and sometimes new forms of organisation.

By offering different financing models, equipment manufacturers can help reducing the investment costs of their customers which might otherwise be prohibitive for purchasing the equipment. Build-operate-own models also aim at reducing initial investment costs for equipment through new business models such as producing certain products at own facilities or operating manufacturing equipment on behalf of the customer. The difference between traditional and advanced services manifests itself empirically in the share of enterprises which offer different types of services to their customers. As shown in Figure 1, between half and more than two thirds of all German manufacturing firms, respectively one quarter to two thirds of Spanish frims already offer traditional types of product related services to their customers. The most frequently offered forms of services both in Germany and in Spain are consulting/project planning and technical documentation. Services which can be considered advanced as outlined above are clearly less fequently offered. One fourth of German firms and one tenth of Spanish firms undertake software development for their custormers, but only around 10 percent of enterprises are currently offering build-operate-own models or financing solutions like leasing/renting.

Product related services are furthermore not of equal importance in every sector. In some sectors, certain types of services are less required than in others due to different structures and types of products. While for example machine tool manufacturers and manufacturers of medical instruments need to offer maintenance services and to deliver specialised software if required, these forms of service are not of such importance for firms in the chemical or food industry. A more detailed data analysis for Germany shows that manufacturers of machinery, electrical devices and medical instruments are indeed leading in terms of offering advanced services such as software development, leasing/financing or build-operate-own models. Between 46 and 71 percent of firms in these sectors offer at least one of those three advanced forms of services, indicating that a close involvement with the customer is essential in these industries. On the contrary, such advanced forms of product related services are much rarely found in other industries like food or plastics (16, respectively 20 percent).

The offer of advanced product related services does not only differ across sectors, but also across firm sizes. However, differences according to firm size are less significant than those related to sector. Advanced services are offered by more than one third (36 percent) of SMEs and almost half (48 percent) of all large German firms in the dataset.[1] In the case of Spain, this share is less, where around one third of both SMEs and large firms are offering advanced services to their customers. These results clearly show that not only large firms are capable of supplementing their product portfolio by advanced forms of product related services. A considerable share of SMEs in different countries equally pursues an innovation path based on advanced service solutions.

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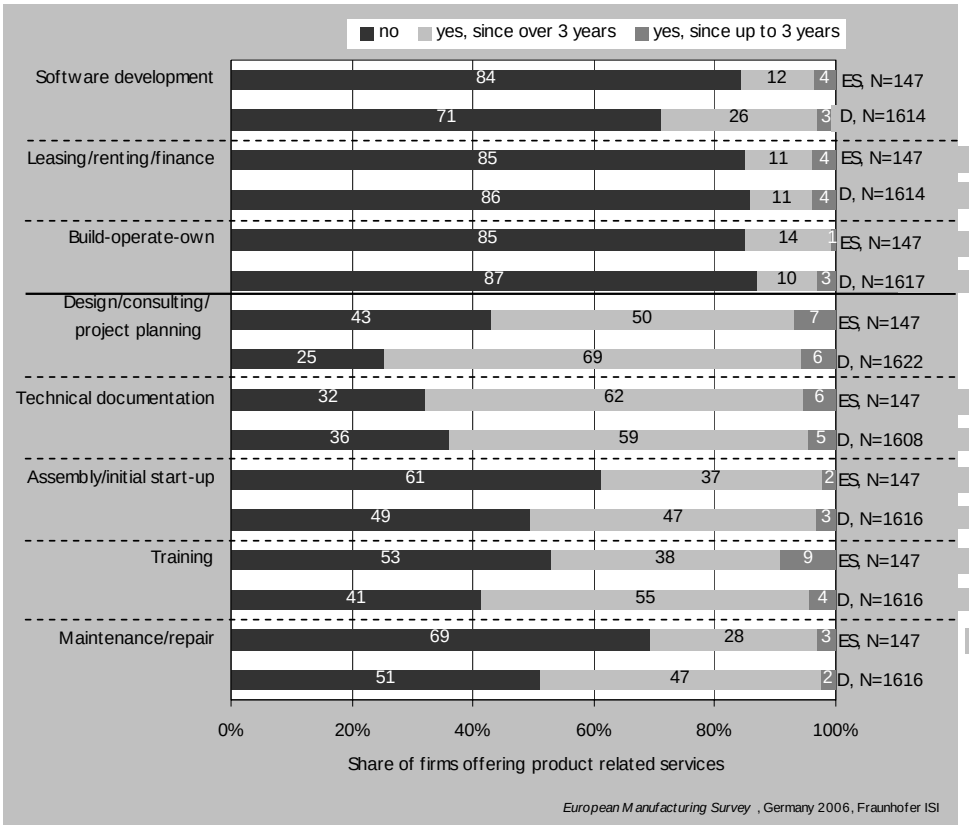
and selected European countries. The analysis presented in this paper draws upon data from the latest survey in the year 2006.

[1] SMEs are defined as firms with up to 250 employees, according to the definition of the European Commission.

Figure 1: Product related services in the manufacturing sector – cross country comparison between Germany and Spain



However, not all firms offer product related services on their own. Around one third of firms both in Germany and in Spain are sustaining service collaborations with other firms in order to combine their resources in this area. Service collaborations can offer different advantage, such as better geographical proximity to customers or enlargement of the service portfolio. By combining the resources of different firms, a better service coverage and quality can be achieved. Service collaboration clearly increases with size in case of German manufacturing firms. One fifth of small German firms up to 49 employees have reported to collaborate in the area of service, compared to 40 percent of large firms with more than 250 employees. This indicates higher collaboration barriers in SMEs which might be due to their limited ressources and their reservations towards potential loss of know-how.

III Effects of product related services

Product related services are not only a means to achieve market differenciation and customer satisfaction but can also contribute to firm´s financial performance. Our empirical analysis shows that on average as much as 10 (Spain) to 15 (Germany) percent of the total sales of manufacturing firms result from product related services. The highest average shares of sales with services in Germany are to be found in firms manufacturing machinery (19 percent) and medical devices (18 percent). Sales with product related services are however accounted in very different ways. One part is directly accounted, whereby customers are paying separately and directly for the service, the other part is indirectly accounted through an overall increase of the product price. The proportion between directly and indirectly accounted sales with product related services is almost balanced (50 percent) in the machinery or electrical sector, whereas in the chemical or plastics industry product related services are mainly accounted indirectly. These results indicate that customers of machinery and electrical devices are more prepared to pay directly for services than cusomers in other industries. Manufacturers seem to responde to

these differences and to choose the mode of accounting according to the conditions of the respective industry. In the German sample, small companies up to 49 employees are generating the highest share of sales with product related services, taken together both directly and inidrectly accounted parts. Almost one fifth (18 percent) of the total sales in these small manufacturing firms results from services, slightly more than in medium sized or large companies (15, repectively 14 percent). In the Spanish sample, a similar pattern can be observed, even if on a smaller absolute scale. Small and medium size Spanish firms are also achieving higher shares of sales (10, respectively 12 percent) with product related services than their larger counterparts (5 percent). These results show that many SMEs in both of these countries follow a substancial service strategy and benefit from their close interaction with their customers. They seem to succeed not only in offering services additionally to their products, but also in converting this offer into sustained financial success. Remarkably, SMEs are able to achieve these financial benefits mainly on their own. As shown previously, SMEs collaborate to a considerably lesser degree with other firms in the area of service compared to large firms, which indicates that the service offers of SMEs are realised with mainly own internal personal, technical and organisational resources. Therefore, a high potential for collaboration can be assumed for SMEs if they can overcome existing collaboration barriers and are able to identify possibilities for synergies.

Further empirical analysis through a linear regression model reveales that the share of sales with product related services is positively correlated with the offer of advanced services, complex products, a high share of skilled workforce and single unit manufacturing or small batch sizes, while negatively correlated with high export rates. These results empirically confirm commonly held assumptions about product related services: complex products, which are mainly manufactured as single units or small batches, require a higher extent of accompanying services, for example in form of training, software or maintenance. This is also related to the skill level of the workforce, because complex products and the different services related to them tend to require highly skilled employees. Since product related services are provided in close connection with the customer, this implies that firms which export a high proportion of their products to other countries might offer less product related services, due to the existing geographical distance to their customers. These firms probably need to rely more strongly either on service cooperations or on complete outsourcing or offshoring of service tasks to other firms which are located closer to the customers. Furthermore, the offer of advanced services is equally expected to be positively correlated to the sales with services, since these types of services are of sophisticated nature and generate high value for customers.

IV Conclusions

The empirical analysis on basis of German and Spanish firm level data revealed that product related services play an important role in manufacturing companies. Products are supplemented by a wide range of different services which not only serve as competitive advantages through differenciation but also contribute significantly to the sales of manufacturing firms. As expected, the extent of service offers differs strongly between sectors, but also between SMEs and large companies. However, SMEs are able to achieve comparable or even higher benefits from product related services compared to large firms. Supplementing their products by different services seems to be a promising strategy for both small and large firms.

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A Comparative Analysis of University Technology Business Incubators in China and in France

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Abstract: This paper focuses on the comparison between university incubators in China and in France. It analyses the context of emergence of university incubators in both countries and the similarities and differences existing between both systems. The papers ends with comparing a Chinese university incubator and a French one. It takes **Chongqing University Incubator** and **SEMIA (Science, Enterprise, Market, Incubator Alsace)** in Louis Pasteur University as examples. The methodology used in the paper is based on interviews of directors and management staff working in the two university incubators, but also on a literature review concerning the system of innovation of both countries. Even though both incubators have similar functions, differences are found in terms of incubation system.

Keywords: university incubators, incubated companies, start-ups.

I INTRODUCTION

Promoting the commercialization of university S&T findings and strengthening university-industry linkages have become an important element of the S&T policy in OECD countries. The creation of university incubators (UI) constitutes one of the tools used to implement the governments' policy. Numerous studies on university incubators have started since the 1980s (Mian, 1995). Most of these studies focus on introducing different types of incubator models and trying to design an assessment framework for UIs (Allen, 1985; Campbell et al., 1988; Mian, 1991, 1994a; Chan and Lau, 2005). One of their common research output is that university incubators provide a nurturing environment for new business start-ups. Other researchers underline the success factors of UIs (Rice, 1993, 2001; Colombo and Delmastro, 2001; Lee and Osteryoung, 2004; O'Neal, 2005; Zedtwitz and Grimaldi, 2006). Most of their findings confirm that UIs contribute to the commercialization of university S&T findings.

China and France have, as many other countries, implemented policies to foster science-industry relations and regard university incubators as important means for promoting the creation of start ups and the technology transfer from university to industry. These two countries have set up university incubators taking account of their national specificities. The paper will analyse how university incubators emerged in both countries and how they are performing in China and France. Section II will explain the background of university incubators both in China and in France; section III will focus on the comparison between Chinese university incubators and the French ones; section IV will take Chongqing University Incubator and Louis Pasteur University Incubator as a case study; section V will draw some conclusions.

II BACKGROUND OF UNIVERSITY INCUBATORS IN CHINA AND IN FRANCE

Chinese university incubators are located in university science parks. North East University, located in Shenyang, was the first one to establish a university science park in 1989. The aim of the creation of the university science park was to compensate the sharp cutting-down grant allocation from the governments through setting up university-run firms since S&T system reform in 1985. Seeing no disapprovals from the government, other universities successively established their science parks. The bottom-up spontaneity attracted the government's attention. In 1999, the State Council disclosed the "determination on strengthening S&T innovation, developing high-technology and industrialization", manifesting the government's approval and support towards the development of university science parks. Following the government's intention, the Ministry of Science and Technology (MOST) and the Ministry of Education (MOE) chose Tsinghua University and other 14 universities to establish experimental university science parks in the same year, hoping that university science parks could act as a bridge transferring university knowledge and technology to industry and solve the problem of

loose university-industry linkage. Moreover, the regulations on accelerating the commercialization of S&T findings in 1999 authorize university professors to set up firms based on their research achievements. Many university entrepreneurs choose university science parks to establish start ups. At the end of 2005, 50 university science parks have been set up at the national level. University incubators are embedded in university science parks (USPs), which main role is to nurture new firms. The official statistics available on the MOST website focus on 49 university incubators instead of 50 ones. It might result from the unavailable information on the 50th university incubator.

In 2005, China accounts for a total of 534 technology business incubators sustained by the government, and university incubators represent only 9% of total. Because of a yearly performance evaluation done by the Ministry of Science and Technology, some university incubators lost their state-level university incubator label which led to a decrease of university incubators: from 58 in 2002 to 49 in 2005. The incubation surface followed the same trend. In 2003, the university incubation area reached the peak of 5.784 million m2 and fell to 5.005 million m2 in 2005. University incubators host more and more incubated companies: 2380 in 2002 and 6075 in 2005. In 2005, on average, each incubated companies created 18 employments and each university incubator hosted 124 incubated companies.

The creation of university incubators in France is linked to the challenges faced by the French public research system. At the end of the 90's the French State had created a powerful public research system, but met with difficulties to create a system of intermediation between the research and the economic world. The inadequate connections between the research and the technology systems may be explained by different reasons: few researchers from the public system moved towards industry; there were a limited number of joint laboratories between public research and industry and researchers from the public sector had no incentives to diffuse their results as the effort devoted to those activities were not recognized and valued in their careers. To answer these problems, the French government set up an innovation law in 1999. Its main aim was to enhance university-industry linkages and to accelerate the transfer of public research results towards the society. In 1999, the government also launched a programme of “incubation and seed capital for technology-based firms”, which authorised universities to create incubators. This program should encourage the creation by researchers of technology-based start-ups. Like in Chinese regulations, the French innovation law encourages researchers to take part in high-tech start-ups and they can leave universities or research institutes to create their company. Researchers keep their positions for 2 years in general. If the start up fails, they are allowed to go back to universities. Between 1999 and 2005, the number of university incubators dropped from 31 to 28. One incubator failed and two incubators merged. In that period, 28 incubators welcomed 1415 firm projects. 45% were based on public research results, 52% were external to public research but were linked by collaborations with public research labs. Only a very small part of projects, namely 4%, emanated from private research. At the end of 2005, 844 companies have been created, among which 746 (88,4%) still survive and employ 3560 persons (4,8 employment/active firms). The 28 incubators have contributed to the creation of 160 innovative enterprises per year on average.

III COMPARISON BETWEEN CHINESE AND FRENCH UNIVERSITY INCUBATORS

The objective of this part is to compare Chinese and French university incubators along different dimensions such as the choice of the location of the incubator, the funding system, the services provides, the selection criteria and graduation system and the duration. We would first like to emphasize that the central government is directly involvement in the implementation of university incubators both in China and in France: university incubators are non-profit organizations, highly based on public funding and their aim is to create jobs and sustain regional economic development (Becker, Gassmann, 2006).

The Ministry of Science and Technology together with the Ministry of Education in China, the Ministry of High Education and Research in France play a key role in determining the location of university incubators. Chinese UIs are usually located in a University Science Park or in a S&T Industrial Park. If a region has two or three key research universities, it is not surprising to find two or three university incubators there, like Shanghai and Beijing. In France the Ministry of High Education and Research asked all the public research actors of a same region to coordinate their action and to create a unique university incubator. In some large regions with a high concentration of public research institutions more than one incubator has been set up: Ile-de-France (3), Nord-Pas-de-Calais (2), Provence-Alpes-Côté-d’Azur (3) and Rhône-Alpes (2).

Concerning the source of funding, the governments are the main supporters both in Chinese university incubators and in the French ones. In France, the central government can compensate 50% at maximum of university incubators’ internal and external expenditures (personnel expenditures, overheads, exploitation of incubator and expenses specific to projects). In fact, it covered one third

budget of all university incubators on average from 2004 to 2006 (Bussillet et al., 2006). Except the central government, the Regional Council (Conseil Régional) is another important supporter for French university incubators. Due to unavailable statistics on how much funds from the Chinese government are invested in university incubators, this paper can not compare it with the fund allocated from French government.

Chinese and French university incubators provide different type of services: access to physical resources such as office space, common meeting hall, IT infrastructure; business operation support services such as secretarial and mail services, security systems, firms registration; access to capital, including seed money, venture capital, etc; business development support such as mentoring, coaching, consulting but also legal advice and book-keeping; networking services, both incubator internal as well as external with customers, collaborators, and potential investors (Vonzedtwitz, Grimaldi, 2006). In spite of similar services, the quantity and quality of services provided is different between Chinese university incubators and French ones. French university incubators are aware of the real needs of tenant firms and use internal and external resources to support them. They help tenant firms to establish network contact with graduated and other incubated companies, but also with public research actors and investors. It is very common for incubator staff to get engaged in tenant firms' management. Professional service is available in French university incubators. In Chinese university incubators, the majority service lays emphasis on building and administrative management (Zhang et al., 2004; Sun et al., 2005). Follow-up service and network platform construction for tenant firms are not really widespread, except some best practices of university incubators, like Tsinghua university incubator.

Although financing service is provided by university incubators, both Chinese and French tenant firms complain insufficient financial help from the incubators. At the early stage of start ups, the majority of entrepreneurs have to depend heavily on self-raised funds, such as personal deposits, money borrowed from family members and friends. Business angels, venture capital, seed funds and bank loans are rather limited. In French university incubators, 769 firms (91% of total firm creation) were created based on self-funding in 2005. However, start-ups can apply for financial help from the National Fund for Creation of Technology-based Innovative Firms and from seed capitals, which are implemented by the Ministry of High Education and Research. Each fund has specific supporting target. For example, at the very early stage, French start-ups can apply for the National Fund for Creation of Technology-based Innovation Firms. An "emerging" project needing additional time to become more mature (technical, legal and economic validation), can ask for 45000 € at maximum; for a project at a creation-development stage. Once the start up is created, it may be financed by OSEO Anvar (a public organization devoted to support and fund innovation in SMEs, somehow similar to Chinese Innovation Funds). For Chinese university incubators, they usually help tenant firms to apply for Innovation Funds for Technology-based Small and Medium-sized Enterprises (Innofund) given by the Ministry of Science and Technology. In 2005, the average support from Innofund per project reached 769, 612 RMB which was much lower than the financial support from French national fund for creation of technology-based innovation firms. At the same year, in Chinese university incubator, over 49% of available funds for tenant firms came from self-raised funding, and the government support only accounted for 2.9%. Most of the government financial support was allocated through various national S&T programmes competition. 51% of these programmes were carried out by innovation funds for technology based small and medium-sized firms.

Item	2002		2003		2004		2005	
	C*	F*	C*	F*	C*	F*	C*	F*
Nbre of university incubators	58	30	58	29	46	28	49	28
Nbre of tenant firms	2380	635	4100	964	5037	1139	6075	1415
Nbre of staff in tenant firms in China and active firms in France*	51576	1854 (267)	70855	2665 (426)	69644	3126 (566)	110240	3560 (746)

Table 1: The development of university incubators in China and in France (2002-2005)
Source:http://www.chinatorch.gov.cn/yjbg/200610/101.html and bureau DTC2, France
Note: C* hereafter refers to Chinese university incubators. From 2004, university incubators refer only to the state-level ones. F* refers to French university incubators. Number of tenant firms*: it means the number incubated companies. * the number within() represent the number of created active French firms.

University Incubators in China and in France

The number of university incubators is higher in China over the period 2002 to 2005. But the number of French university incubators kept rather stable, around 29. In general, the scale of Chinese university incubators is larger than French ones. For example, in 2005, Chinese incubators welcomed 4.3 times more tenant firms than French counterpart. Concerning employment, the statistics are not directly comparable: Chinese figures provide the employment of incubated companies and French statistics underline the employment of created active firms (some of which are no more incubated). In China, 18.15 employments per incubated firms were created while in France the created active companies employ 4.8 person per firm. French incubated start-ups seem to be more hi-tech based than Chinese ones. In France, except 32 firms created in social human science and services, the remaining 812 firms (96%) are involved in hi-tech field, such as life science and biotechnology (36%), ICT (33%) and engineering technology (27%). In China, among 6075 tenant firms, only 1746 were assessed as hi-tech firms (29%) and 63.57% of these hi-tech firms were created by professors and students. For the French side, 50% of the leaders of incubated projects are coming from universities of public research organizations. In terms of hi-tech firm creation, Chinese and French scientists seem to have similar entrepreneurial behaviour. Nevertheless, the survival rate of firms in French university incubators reached 88.4% on average at the end of 2005, whereas in China the average rate was lower than that. Only can some best practices of incubators keep such a high survival rate, like Tsinghua University Incubator.

The divergence may result from different incubation selection system and services. French university incubators have no clear registered capital requirement. Incubators welcome start-up entrepreneurs based on their innovation ideas and commercial potential. The incubator organizes a first selection; afterwards one or more committees continue to examine the first selected projects and approve them. These committees sometimes even follow up the development of the project. The committee members are high level professional, coming from firms, incubators (finance manager), start up creators, banks… Once selected, the tenant firms benefit from different services provided by the incubator from the beginning till their graduation. Another selection criterion emphasises the incubation project coming from public research labs or linking with public research findings. Many studies confirm that university-related tenant firms are more successful than other tenant firms (Mian, 1995; Lee and Osteryoung, 2004; Rothaermel and Thursby, 2005). The average incubation period in France is 16 months. There is no formal graduation of companies which want to exit the incubators. The exit is validated by the same committee which selects the projects. In China, the selection criteria pay much attention to tenant firms' R&D activity and production orientation and impose an initial capital threshold to the entrant companies, e.g., a minimum requirement of registered capital, varying from 3000 euros to 50000 euros. The average incubation period is 3 to 4 years depending on the industrial sector. In china, the company that decides to exit the incubator should apply for graduation. In general, the incubator decides the graduation taking into account the rules defined by the local and national government rules. A graduated company can benefit from different tax exemptions and other policy means. It seems that French start ups enter the incubator at an earlier stage than the Chinese ones. French innovators use the incubation stage to create the company (capital, legal status, production plan etc.) while Chinese start-ups are closer to the creation stage (capital creation requirement). French start-ups leave the incubator at an earlier stage and go to "pépinières" (or company "nursery") that will provide additional material services for one or two more years. The Chinese incubation system seems to correspond to the French incubation plus pépinières one. This largely explains the difference in terms of incubation period between both countries.

In order to make a clearer comparative study, the section IV will analyse Chongqing University incubator and Semia the Louis Pasteur University incubator.

IV CASE STUDY

We will first briefly describe the two incubators in brief and then compare them with regards to their performance.

Chongqing University Incubator is located near Chongqing University Campus. It was set up in 2000 with a registered fund of 20 million RMB, co-financed by Chongqing University, Jialing Motor Company and the district government Shapingba (much smaller than Chongqing municipal government, in which there are 6 district governments). At that time, the Shapingba district government did not provide free land as did many local governments in China, because there was no available land near the campus. In consequence, the incubator had to rent some buildings left unused besides the campus. This increased its operational costs and did not constitute a particular favourable situation.

It is interesting to note that SEMIA was built within University Louis Pasteur to commercialize the research of the different universities and public research organizations from the Alsace Region in the

same year (2000). It is funded by the Ministry of High Education and Research, Alsace Region and European Commission. SEMIA is located in different sites whereas Chongqing incubator is much bigger in terms of square meters but located in one geographical size. The Chinese incubator host much more incubated start-ups than the French one: 122 against 45. Interesting enough, the two incubators have created approximately the same number of graduated companies. The French incubator seems much more efficient in terms of firm creation: 34 out of 45 against 32 out of 122. But we have to remember that the incubation period is almost double in China as compared to France.

	Chongqing Univ.	Louis Pasteur Univ.
Nbre of incubated firms	122	45
Surface m2	16443	2000
Nbre of sites	1	3
Nbre of graduated firms	32	34

Table 2: characteristics of both incubators 2000-2005

In terms of employment, Chinese and French figures are difficult to compare in a strict sense. For SEMIA, the 34 created companies (5 of them have disappeared) employ 150 persons. We have no information about the number of employed person during the incubation period. In Chongqing, the 122 incubated start-ups have created 1881 employment, but we have no information about the number of employees in the 32 graduated companies. This difference in statistics clearly reflects the difference in the incubation system in both countries (China longer incubation period than France and include more development stages). Nevertheless, the Chinese incubated companies are bigger in terms of employment than the French created start-ups (after incubation). The average employment is 15,4 employee by incubated companies in Chongqing and 5,2 employees by active created companies in Alsace.

In terms of industrial sector again the comparison is difficult as in China data is available for incubated start-ups and in France for the created ones. In Chongqing, the distribution of incubated firms by sector is the following: 46% tenant firms engaging in information technology; 10% in Optical, mechanical and electronic integration; 8% in biotechnology, pharmacy and medical equipments; 21% in environment protection, energy saving and new materials; 2% in modern agriculture, and 14% take part in other activities. In SEMIA, the created companies (34 firms) concentrate on a certain fields, such as 42% in life science, 32% in ICT, 22% in chemistry & engineering, and 4% in social human science and services. From the above statistics, the activities of Chinese tenant firms are more diversified than those of French created firms. French firms show more interest in life science whereas Chinese ones are more interested in IT. The reason may be relative to university's specialty. Louis Pasteur University is very strong at life science research and Chongqing University is good at IT.

V CONCLUSION

Even though Chinese and French university incubators have similar characteristics, their incubation system is different, such as selection criteria for candidates of tenant firms, funding sources, incubation period as well as performance result. No matter in which context these universities incubators run, they do contribute to local economic development with respect to employment creation. In general, Chinese ones host more tenant firms than French one, namely 6075 against 1415. And Chinese university incubators have much larger incubation surface than French ones. Besides, the former creates about 31 times of employment than the latter. Why do Chinese university incubators attract more start ups than French counterparts in spite of the registered capital requirement in Chinese ones? Do Chinese universities provide more efficient incentive mechanism to university staff than French ones? The question would be addressed in our forthcoming research. But with regard to their graduated firm number, French counterparts seem to be more successful. The success can be learned by Chinese ones: emphasize the relationship between incubation projects and S&T achievements from universities and public research organization when selecting tenant firm candidates, diffuse follow-up service in all Chinese university incubators, and help tenant firms to establish network contact with graduated and incubated companies, but also with public research actors. And French university incubators can learn from Chinese ones: leave enough physical space for the further development of tenant firms, which is especially important to keep graduated tenant firms stay in Alsace; design clear assessment criteria for graduation of tenant firms like in China.

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An Organizational Memory-based Environment as Support for Organizational Learning

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Abstract: Information and Communication Technologies have transformed the way people work and have a growing impact on long life learning. Organizational Learning is an increasingly important area of research that concerns the way organizations learn and thus augment their competitive advantage, innovativeness, and effectiveness. Within the project MEMORAe2.0, we are interested by the capitalization of knowledge and competencies in the context of an organization. We developed the E-MEMORAe2.0 environment which is based on the concept of learning organizational memory. This environment is meant to be used by a Semantic Learning Organization as support for Organizational Learning. In such an environment, actors of the organization use, produce and exchange documents and knowledge. To that end, they have to access the resources and to adapt them to their needs. In this paper, we present the organizational learning approach, we stress the role of an organizational memory in this approach and we show how it enables knowledge transfer processes. Then we present the project MEMORAe2.0and we describe how we implemented the organizational learning approach in the E-MEMORAe2.0 environment.

Keywords: Organizational Learning, Organizational Memory, Community of practice, Knowledge Representation, Ontologies.

I. Introduction

Organizational Learning (OL) is an increasingly important area of research that concerns the way organizations learn and thus augment their competitive advantage, innovativeness, and effectiveness. OL requires tools facilitating knowledge acquisition, information distribution, interpretation, and organization, in order to enhance learning at different levels: individual, group and organization.

In the Information Systems context, the "Semantic Learning Organization" (SLO) is an emerging concept that extends the notion of learning organization in a semantic dimension. A SLO must be considered as a learning organization in which learning activities are mediated and enhanced through a shared knowledge representation of the domain and context of the organization (Sicilia & Militras 2005).

Within the project MEMORAe2.0[1], we are interested in knowledge and competencies capitalization in the context of organizations and more precisely the capitalization of the resources related to these knowledge and competencies. We particularly focus on the way members of an organization could use this capitalization to get new knowledge and competencies. To that end, we developed an environment based on the concept of learning organizational memory. This environment is dedicated to be used by a SLO. In such a system the learning content is indexed on knowledge and competencies organized by the means of ontologies. Users can acquire knowledge and competencies by doing different tasks (solving problems or exercises, reading examples, definitions …). In our memory, competencies are defined via knowledge they enabled by practice.
In the following, we present the organizational learning approach; we stress the role of an organizational memory in this approach. Then we present the project MEMORAe2.0 and we describe how we implemented the organizational learning approach in the E-MEMORAe2.0 environment.

[1] In French, Mémoire organisationnelle appliquée au e-learning.

II. Learning organization / Organizational Learning

A learning organization (LO) is an organization in which processes are imbedded in the organizational culture that allows and encourages learning at the individual, group and organizational level (Sunassee and Haumant 04). Thus a LO must be skilled at creating, acquiring, and transferring knowledge, and at modifying its behaviour to reflect knew knowledge and insights (Garvin 1994). According to (Dogson 1993), a LO is a firm that purposefully constructs structures and strategies so as to enhance and maximize organizational learning (OL).

An organization cannot learn without continuous learning by its members. Individual learning is not organizational learning until it is converted into OL. The conversion process can take place through individual and organizational memory (Chen & al 2003). The results of individual learning are captured in individuals' memory. And, individual learning becomes organizational learning only when individual memory becomes part of organizational memory.

Finally, OL seldom occurs without access to organizational knowledge. In contrast to individual knowledge, organizational knowledge must be communicable, consensual, and integrated (Duncan and Weiss 1979). According to (Chen & al 03), being communicable means the knowledge must be explicitly represented in an easily distributed and understandable form. The consensus requirement stipulates that organizational knowledge is considered valid and useful by all members. Integrated knowledge is the requirement of a consistent, accessible, well-maintained organizational memory.

III. Organizational Memory

According to (Stein & Zwass 1995), an organizational memory is defined as "the means by which knowledge from the past is brought to bear on present activities and may result in higher or lower levels of organizational effectiveness". It can be regarded as the explicit and persistent representation knowledge and information in an organization, in order to facilitate their access and their re-use by the adequate members of the organization for their tasks (Dieng & al 1998). Thus, an organizational memory seems indispensable for organizational learning. An integrated organizational memory provides a mechanism for compatible knowledge representation, as well as a common interface for sharing knowledge, resources and competencies.

Organizational memory can be made of both hard data such as reports, articles but also soft information such as tacit knowledge, experiences, critical incidents, and details about strategic decisions. We need ways to store and retrieve both kind of information. Indeed, ideas generated by employees in the course of their task seldom get shared beyond a small group of people or team members. This informal knowledge or non canonical practice is the key to organizational learning (Brown & Duguid 1991). New collaborative technologies should be designed based on this informal knowledge, or communities of practice. The use of information systems to manage organizational memory improves precision, recalling, completeness, accuracy, feedback, and reviewing, far better than the human beings currently involved in organizational memory.

IV. THE PROJECT MEMORAe2.0

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 by means of a learning organizational memory. We particularly focused on the way organization actors could use this capitalization to get new knowledge. To that end, we developed the environment E-MEMORAe as support for e-learning. In such a system a learning content is indexed to knowledge organized by means of ontologies: domain and application. The domain ontology defines concepts shared by any organization; the application ontology defines concepts dedicated to a specific organization. Using these ontologies, actors can acquire knowledge by doing different tasks (solving problems or exercises, reading examples,

definitions, reports…). We used Topic Maps (XTM, 2001) as a representation formalism facilitating navigation and access to the learning resources. The ontology structure is also used to navigate among the concepts as in a roadmap. The learner has to reach the learning resources that are appropriate for him. E-MEMORAe was positively evaluated (Benavache & al 2006).

Within the project MEMORAe2.0 we are interested in using the MEMORAe approach in an organizational learning context. To that end, we take into account different levels of memory and different ways to facilitate exchanges between the organizational actors. The environment E-MEMORAe2.0 has been designed and is meant to be used by a Semantic Learning Organization (SLO). In such an environment, there is a difference between knowledge and resources of: a) the whole organization; b) a community of practice in the organization – the organization is constituted of different communities of practice even if it can be seen as a community of practice itself; and c) an individual.

For example, when actors need to know who works on a project, they have to access 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 different resources. In case of exchange resources, they can exchange ideas or information (externalization of tacit knowledge). Thus, learning can occur by means of these different resources, for example by: Asking a question to the right person (the one who is described as an expert: (s)he worked on a project linked to the searched knowledge…); Asking a question to everyone concerned by a subject (newsgroup); Reading the right rapport, book… (communication resources); Performing the right exercise, problem, QCM (action resources)...

To that end, we designed the organizational learning memory around two types of sub-memory that constitute the final memory of the organization:

- Group memory: this kind of memory enables all the group members to access knowledge and resources shared by them. The group is at least made of two members. We distinguish three types of group memory corresponding to different communities of practice:
    - Team memory: The team memory capitalizes knowledge, resources, communication concerning any object of interest of the group members.
    - Project memory: The project memory capitalizes knowledge, resources, communication concerning a project. All the information stored is shared by the members who work on the project.
    - Organization memory: this memory enables all the members of the organization to access knowledge and resources without access right. These resources and knowledge are shared by all the organization members.
- Individual memory: this kind of memory is private. Each member of the organization has his own memory in which he can organize, and capitalize his knowledge, resources.

These memories offer a way to facilitate and to capitalize exchanges between organization members.

For this purpose, we extended MEMORAe ontologies to represent these sub-memories and exchange resources.
To validate our approach, we reused the two pilot applications developed in the framework of MEMORAe. The first one concerns a course on algorithms and programming at the Compiègne University of Technology (France) and the second one concerns a course on applied mathematics at the University of Picardy (France).

Our objectives within E-MEMORAe2.0 (see Figure 1) are to help the users of the memory to access and exchange information about organization knowledge at anytime. To that end, users have to navigate through the application ontology that is related to the organization, to visualize the indexed resources thanks to this ontology, to ask for questions or make remarks thanks to this ontology... These actions are possible according to their memory access rights. It should be noted that all the memories are structured around the same ontology, they differ only by the indexed resources.

At each step, the general principle is to propose to the learners, either precise information, resources on what they are searching for, or links allowing them to continue their navigation through the memory.

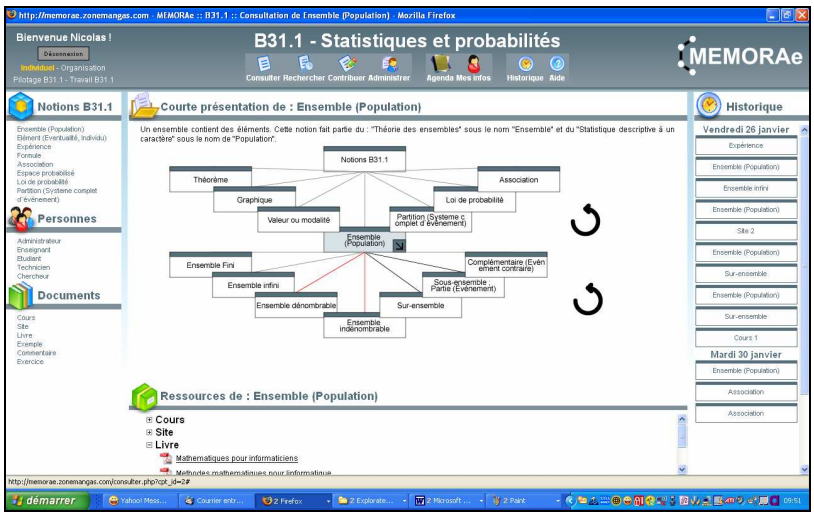

Figure 1: Navigation in the memory (in French).

V. Conclusion

In this paper, we presented the organizational learning approach followed in the framework of the project MEMORAe2.0. We showed how we implemented it in the E-MEMORAe2.0 environment for academic organizations. The main component of this environment is an organizational memory that enables knowledge transfer at three levels: individual, group and organization. A first evaluation of this memory, that was restricted to the organization level, has given encouraging results. Students appreciated to have access to documents by the way of the course concepts. In order to complete this evaluation, we plan now to experiment the two other levels through project-based activities. We also plan to examine to what extent industrial organizations, and companies could benefit of this approach. However it should be noted that software environments are not sufficient to promote organizational learning. It is also a question of culture, as well at university as in any other organization.

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A Decision Support System for Complex Products Development Scheduling

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Abstract: This paper investigates the problems of project scheduling at the design stage of the development of a civil aircraft. Such a complex system development is characterised by a dynamic environment and uncertainties concerning the duration of design activities. In order to deal with the characteristics of the design process reality, we propose a Decision Support System based on a Constraint Satisfaction Problem model that supports three main functions: plateau level scheduling, dependencies between design teams and scenarios management. Our approach is aimed to be generic while remaining flexible enough to be implemented within the aerospace industry. It should facilitate cooperation between design teams and support the decision making process at different managerial levels.

Keywords: Design, Project Management, Scheduling, Scenarios, Dependencies.

I. Introduction

Product development complexity can be characterised on one hand by the large number of physical items to be integrated with multiple connections that might be difficult to control (structural complexity). On the other hand, it can also be characterised by process complexity, which deals with product development activities, taking into account items such as design procedures, skills organisation, work distribution, decision procedures, etc. and that is mainly characterised by the numerous interactions between development teams. Consequently, the development of a new civil aircraft can be considered as complex from a product and process point of view.

Development of complex products has been discussed by numerous papers and influential publications (ULRICH and EPPINGER 2004). However, current development projects prove that there are still major challenges to be addressed in controlling target dates and resources allocated to a specific project (GAREL, GIARD et al. 2004). The risk of overrunning is particularly high in aircraft industry where resources and budget engaged are important. Facing this situation some correctives actions might be taken (e.g. late allocation of resources based on outsourcing or hiring new personnel, planning changes, etc.) but they might affect the company's operational performances.

II. Needs for complex systems development scheduling approach

In order to manage the functional and structural complexity of large systems development, design groups are located in the same environment and generally derived from the product breakdown structure (PBS). These groups are called "Plateau". For a limited period of time, these plateau made of different but consistent skills that will strive to reach common objectives related to the development of a specific subsystem.

Plateau level schedules are one of the key tools for the programs managers at system levels. They allow managers to control the plateau's activities progress status and help him in the decision-making process concerning task definition and resources allocations. For design activities in plateau level scheduling, a majority of methods assume that information to build schedules are available, stable and complete (e.g. activities duration). However, facts show that design processes are exposed to a significant level of uncertainty.

Plateaux have been an efficient answer to reduce developments costs and time to market. Nevertheless, the organisation structure based on plateaux has accentuated some of the problems characterising complex product developments. Indeed, organisation structures based on plateaux have highlighted the need to manage efficiently internal resources and to satisfy agreed time constraints. Therefore, the importance of dependencies with other plateaux has to be emphasized; otherwise the risk of loosing a systemic vision of the entire product is becoming higher.

Dependencies between design teams can be identified when data exchange is requested. Data is a generic term used to describe deliverables exchanged between design teams. Different models, drawings, mock-ups, requirements specification documents, calculation results, sketches, test results, etc can be part of the deliverable. The content, maturity level and delivery date of the exchanged deliverables are often subject to negotiations (SAINT-MARC, CALLOT et al. 2004). Consequently, dependencies management often refers to interfaces management, deliverables management, contracts management or interdependencies management.

Therefore, a solution that merges scheduling practices and dependencies management is requested in order to improve the plateau level scheduling process taking into account the uncertainties of the design process reality.

III. A building-block based approach

Our approach is based on use cases provided by a major European aerospace company. A procedure has been set up to analyse the company internal procedures related to Project Management (PM) activities and during semi-structured interviews with team leaders and program management functions.

Our research project is based on a building-block approach that represents a group of functions to be provided to end-users through a Decision Support System (DSS). The underlying PM model enables a Constraint Satisfaction Problem (CSP) approach to solve the dynamic aspects required by the DSS. This model is a pre-requisite for the development of the different building-blocks.

In order to answer to the identified needs, we have developed three main functions. Firstly, we focus on plateau level scheduling. Then, we tackle dependencies management and finally, we propose a scenario based approach to deal with uncertainties.

Before detailing these three features, we describe the underlying PM model.

IV. The underlying PM model: an energy based constraints satisfaction problem

The approach relies on a CSP model. Resources intensities (per activity and per period) are the main variables of the problem. This scheduling problem can therefore be considered as a resources allocation problem.

First, we describe the energy allocation problem based approach, which will be the basis for the modelling of most constraints. Then, we list the set of constraints we model. Implementing this model uses a Constraint Logic Programming (CLP) environment. CLP extends Logic Programming and provides a flexible and rigorous framework for solving CSP models.

1. The energy allocation problem based approach

Activities are mainly defined by their energy. Energy characterizes a quantity of work and is then proportional to time and to the strength/intensity of the resource able to realize it.

Energy is particularly interesting to tackle this specific scheduling problem in which work quantities that define the activities are well defined and can be considered as data, while durations and resource allocations are decision variables. The energy concept enables the definition of specific constraint propagation algorithms (see for example, (BRUCKER 2002)) useful both to characterize the problem consistency but also to improve the resolution process, by reducing dynamically the domain of remaining variables, after each decision step. The main idea of this so-called energy-based resolution approach is to deduce restrictions on time location and resource allocation for one activity by taking into account the resource availability and the minimal resource consumption of the remaining concurrent activities. This kind of reasoning has been successful in many scheduling problems (see (ESQUIROL, LOPEZ et al. 2001)).

2. A Constraint Satisfaction Problem model

In our problem we consider full elastic pre-emptive activities (BAPTISTE, LE PAPE et al. 1999): the duration of an activity is not known in advance and its intensity can vary during its realisation.

Concerning constraints, the first three types of constraints of our model are easy to express and have already been discussed by numerous papers: Activity energy constraint, Cumulative resource constraint, and the Time window constraints (DEMEULEMEESTER and HERROELEN 2002).

The next two constraints are related to interdependencies between two activities. On one hand, we have proposed an interdependency constraint that deals with a pair of activities belonging to the same design team schedule: the Energy-Precedence Constraint (EPC). On the other hand, we have modelled the interdependencies between two design teams, which are usually formalised by contracts, using a new type of constraint: Contract Dependencies Constraints (CDC). On the contrary of classic scheduling problems, our model takes into account dependencies as constraints as essential features to describe a scheduling problem. Dependencies that are negotiated between design teams shall be treated as dynamic constraints in design schedules.

V. Capabilities of the Decision Support Systems (DSS)

Based on this CSP model, we have developed a decision making support tool that offers the user three main capabilities.

Firstly, our DSS deals with solving plateau level scheduling problems. In standard resource-constrained project scheduling problem, the objective is usually to find the schedule that minimizes the makespan or the maximum lateness, with the help of a black-box one-step solving algorithm. In our case, two types of solving strategies are proposed, both based on the CSP model. On one hand, we can design a solving strategy interacting with the user, who defines a hierarchy of constraints that enables if the problem is over-constrained to relax first the weakest constraints (e.g. the user might consider that respecting a review date is a weaker constraint than respecting resources allocation for that period). On the other hand, we can design a heuristic solving strategy mainly characterised by the order in which decision variables are instantiated and by the order in which values are enumerated for each variable instantiation (maximum values first, minimums or midpoints, etc).

Secondly, the DSS proposes a frame to deal with different scenarios. The scenario management process project includes scenario generation and scenario evaluation. A scenario is a description of the original schedule, the possible events that might affect it and their impacts. For the scenario generation phase, three method to generate scenarios are available based on the CSP model. The first one is creating schedules as described in the paragraph related to plateau level scheduling problems solving. The second method is based on the modification of one or several variables and the analysis of the impact on other variables and

constraints. This method is known as sensitivity analysis. In the third method, the user inverts the process in order to create new scenarios. This method is called a goal-seek analysis due to the fact that the user can build a schedule respecting all its goals but without taking into account some external constraints. Once the scenarios are generated, an evaluation is performed based on a risk analysis process. For each scenario likelihood is defined as well as an impact factor. A combination of both factors allows the user evaluate each scenario and make comparisons between different scenarios as well as to order hierarchically a set of scenarios. Therefore, different evaluated scenarios are available so project managers can decide which one to use as a planning baseline.

Thirdly, dependencies between design teams have a key function in our DSS. First, dependencies have been modelled as a new constraint that is included in our CSP model. Dependencies management is also the basis of propagation procedures in our DSS. Indeed, taking into account the dynamic nature of the design process, the issues of changes propagations in constraints and schedules become crucial. Each time a design team updates its own schedule, especially after an unforeseen event, the information is transferred to other teams it has some dependencies with. Contracts related to these dependencies will be included in the schedules allowing the identification of decisions impacts and effects on different design teams by managers.

Specific features related to these capabilities have been tested with two prototypes of the tool. Based on prototypes' evaluation and feedback, an advanced prototype will be released in 2007.

VI. Conclusions

Based on empirical studies, we have investigated the plateau level scheduling process. In our proposal, the problem is considered as a discrete Constraint Satisfaction Problem. The proposed solution includes the energy allocation based approach and the mathematical definition of two new types of constraints for resources allocation. These foundations contribute to the identification of scenarios and to the management of dependencies between design teams. To illustrate these proposals the capabilities of the first prototype developed have been presented.

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Creating Cultural Change with Employees Transferring Through TUPE

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Abstract: Frequently when employees transfer from one employer to another due to a business purchase, sale or award of a contract, the new employer needs to change the behaviour of the employees to be able to generate the success and returns for the business envisaged. This change of behaviour can be difficult to create. In this paper, the author describes some of the reasons for the difficulties experienced, and provides the outline of a process undertaken with employees in two different organisations, which played a significant role in generating commitment, with measured changes in organisational behaviour.

Although analytical methods were used to identify issues and track changes, the changes themselves were born of the trust generated through the process, and of the bonding that occurred within the management team as difficulties were overcome and progress made. This paper shares the value of approaching such change through a combination of traditional project management and non-traditional emotional management.

Keywords: Culture, change, behaviour, process, trust

I. Introduction

As the business climate has changed over the last 20 years, there has been a substantial shift from companies and organisations remaining largely intact, to such organisations continually changing their shape and structure to try to find the best 'fit' for the business going forward.

As this realignment occurs, employees are moved from one employer to another, and sometimes, within a particularly difficult or fluid market, this process can take place several times before an owner finally decides to stay with the business, or to close it down. Although in the UK, the employees' terms and conditions are protected under the Transfer of Undertakings (Protection of Employment) Regulations (TUPE), most employees will be aware that part of the sale and restructuring may require cost savings through for example integrating the business and creating economies of scale, or downsizing. Whatever the reality, at the point of transfer, emotions are high and the new owner needs to decide how and when to meet the challenges facing the organisation. This paper discusses some of the key issues which have been observed by the author over many such projects, and describes a methodology which has been shown to be very effective when used in two very different environments.

II. Background issues in major organisational transfers

Often in an acquisition, the incoming management assume that there has been a common approach to management within the organisation, and that the culture has been established over many years of activity. However, where an organisation has been failing, or is being prepared for sale, new managers, and sometimes a new management team, may have been brought in 12-18 months prior to the acquisition to make changes. These new managers bring with them a different way of doing things, and often value different characteristics amongst staff. This, in turn, can create an undercurrent of uncertainty with staff as they try to decide where they sit with the new style of management compared to the old.

In some cases, the management team may not yet be a team. In one project the author was involved with, the senior management team had been put together less than 6 months prior to the sale, and were still getting to know one another at the time the business was sold. The new leader found it strange that there were so many different and sometimes contradictory messages coming back from direct reports. In addition, some managers did not transfer to the new employer, and a new team was forming as gaps were filled with new team members.

Frequently, in these situations, up to the point of transfer, the senior team have been paying great attention to the sale of the business, and have delegated a significant amount of their day-to-day work. As they now start to focus on the business again, some teams will be relieved and hand back work quickly, whilst others will resist this as they have enjoyed the freedom and responsibility. Often, one side effect of this delegation is that small micro-cultures have grown up, all focussed on delivering the task in hand and with the freedom to decide how that delivery should take place. In this climate, it is often the stronger leaders who have taken charge, and a coercive or authoritative style of management has developed.

With the arrival of the new leadership of the business, employees are often wondering what the impact on their day to day lives will be, often preferring to hear that it will be business as usual, but truly hoping that there will be changes and more clarity on their roles and what they are to deliver.

Often, the incoming management team feel that, having seen a lot of money spent in acquiring the business, the employees will be very grateful and will be receptive to the new direction and strategy proposed, ready to get behind it and drive forward for success. In fact, there will be quite a few employees who are in this category, and finding those, particularly those who are opinion formers in the company, early and working with them, is a key point for success.

However, there will be other employees with reservations, waiting to see what happens and who will be the winners and losers in restructuring, which they are sure will be about to happen. Some will be acutely aware that whilst they chose to join the previous company, they did not choose to join this one. Some will just not agree with the new company's stated objectives, or see nothing wrong with the current way of doing things. So whilst there is usually a common interest in continuity of employment, there will be many different perspectives on what that means.

It is important to note that whilst people are generally on edge at this point, the work will still be done, as they want to show the new owners that things are working, and will also want to share how things could be improved from their perspective. The key point is that in an organisation having all of these different perspectives, much energy is being lost each day in the processing and discussion of these differences, with many decisions being made on a case by case basis.

III. Determining the starting point

In these organisations, people tend to notice differences in the organisation and put it down to differing leadership styles. There is little, if any, recognition that they have each experienced, and responded to, the changes in the organisation in their own way. In fact, people respond to the climate at work based not only on their feelings on that day, but also on messages and feedback that has been presented to them over the course of their career. With so many uncertainties, and frequently a need for substantive change, it is difficult to manage transition whilst holding on to the recent past, particularly where the organisation has so many different perspectives.

In the two successful change programmes described in this paper, the principle of creating a shared vision of the future was applied. In both cases, a questionnaire was used to determine how people perceived the working environment around them and to identify the environment that they would like to work in. In these cases the questionnaire was based on the work by Blake and Mouton (1964), but as a tool to determine the employees' experience and desire, for task versus people focus, rather than the conventional use as a tool for leadership assessment.

Everyone in the organisation participated in the survey. The data was maintained as completely confidential, and the results were presented in anonymous graphical format, by workgroup, department and company, and shared with everyone in the company. Individual results were fed back on a one to one basis, via the survey administrator, who could also talk through the meaning of these results with the individual.

The results of the survey were very similar in both cases, despite one organisation being predominantly male, and the other predominantly female, one based in manufacturing, the other

service based. An example of the data is shown in Figure 1 in Appendix 1. Figure 1, shows that the employees perception of the environment they work in are very different indeed, even between those who had been colleagues for years. It also shows that the employees had a much closer view of the environment they wanted to work in, one focused on task but which also allowed people the space and headroom to take decisions.

The impact of this survey on the individuals was huge. Firstly, the recognition for some that everyone saw the work environment so differently created genuine interest in discussing other people's points of view and what gave them that perspective. Secondly, the data presented on the preferred environment was quite shocking to many employees, who had assumed that managers would have wanted a different environment. This was the area where most challenge took place. The key factor in using this survey was not the survey itself. Even if the results had turned out differently, the discussion could then have been held to determine what the common culture was going to be. Whatever the outcome, the survey provided an opportunity for the organisation to create its own 'joint' culture, based on an organisational view rather than a few individuals. Where this approach has failed, it has tended to be because the leadership have hoped to find evidence that their own way is best, rather than being open to a new solution.

This early stage in the new relationship with the organisation is a wonderful opportunity for change. Often, when companies come in and try to impose a new culture without understanding what is currently in place, great resistance is shown. New leaders can find it hard to define why these changes are so much better than the tried and trusted ways.

Other organisations in the author's experience have waited for a while before making change. The effect of this can be that the employees assume that the existing culture is acceptable to the new management. When the organisation then decides a change is necessary, it can be hard work to create enough momentum for change to occur.

Thus, the time window for successful change in this environment can be relatively small, a few months only, and needs to be handled proactively.

IV. Creating Cultural Change

1. Clarity and Consistency

A key first step was provided by the survey, as it identified clearly the direction the organisation was going to take and also identified a number of behaviours, some of which were helpful going forward and some of which had to change. Here the management team also had to decide how they were going change themselves, and approach their staff consistently, and also which aspects were those that were most important to delivering the change, and therefore which ones they were going to consistently reinforce with staff.

2. Sharing

The sharing of the results with the staff was a key factor, both in terms of setting the scene for the next period, and also having frank and open discussions about what that might mean for people within the organisation. Dissent was welcomed, and was generally dealt with by the team rather than the manager. This required a substantial amount of line management time, but it was time well spent as employees could see the programme had been thought through. It also enabled issues to be handled at the start, rather than later in the process. This sharing process continued throughout the change process.

3. Individual Action

Based on the sharing of the information, individuals became more or less comfortable with the new environment. Opportunities to discuss this on a one to one basis were offered, with discussions being very open and honest. For example, where the organisation wanted to increase delegation, training was given to increase people skills where required. Discussions

were held about what was expected within each job role, and leaders were encouraged to discuss the changes with people in terms of their feelings as well as their tasks.

4. Honest Discussion

Where individuals felt that they could not perform in the way that the role was being described, an open and honest discussion was held about what the impact might be. Where challenges were brought to the new way of behaving due to work pressures, the management team worked together to find solutions in alignment with the preferred direction, clarifying their own views and finding consistency as a team. There were those who were not prepared to come on board initially, but in the new environment of being clearer about what was expected of them, they found it increasingly difficult to resist the change. For some, the solution was to move on to new roles elsewhere, for others, changing their approach was easier than they had anticipated.

5. New Ways of Working

As the organisation began to adjust to the new ways of working, further changes were introduced, such as the promotion of individuals naturally skilled at creating the new working climate. Recruitment, assessments and recognition became more closely aligned with the new outputs, and managers focussed on encouraging the new ways of working. Part of the success of this approach was that people wanted to make the change, because they believed that they would create the environment that they would prefer to work in.

6. Tracking and Measuring

In both cases, the movement towards this new environment was part of a larger, transformational change programme, and was tracked and measured in the same way as other, more traditional improvement projects, with key targets specified and met, for example ensuring everyone had a staff assessment. A part of this process was to repeat the survey after 6 months and see how the culture had changed.

7. Accepting Loss

Both organisations recognised that some individuals would leave the organisation either by choice or by circumstance. In both cases, the management teams treated the employees with compassion, and were seen to do so, without compromising the direction or speed of the changes.

8. Building Trust

A combination of clear leadership and direction, consistency, working towards solutions rather than blame, compassion, a co-created new environment, and an acceptance of dealing with the emotional needs of the staff all helped to create an environment of trust within the organisation. As trust grew, the changes were implemented more smoothly than before, and with fewer challenges.

V. Conclusions

At the end of six months, changes were apparent in both organisations, and the change teams started to withdraw. Figure 2 in Appendix 1 shows the change in the way that employees now viewed their environment, with a much closer agreement on the environment experienced and also some small changes in the direction they now wanted to go. Both had now gone back to the step of clarifying their objectives, as shown in the flowchart in of Figure 3 in Appendix 1.

Comments from both organisations at the end of twelve months were that performance of the organisation was much stronger and that the organisation was still evolving. Interestingly, both organisations were also very clear that they did not want to move back to the ‘old ways’, indicating that significant and lasting change had occurred.

Acknowledgements

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Appendix 1 : Figures 1 to 3 from the paper

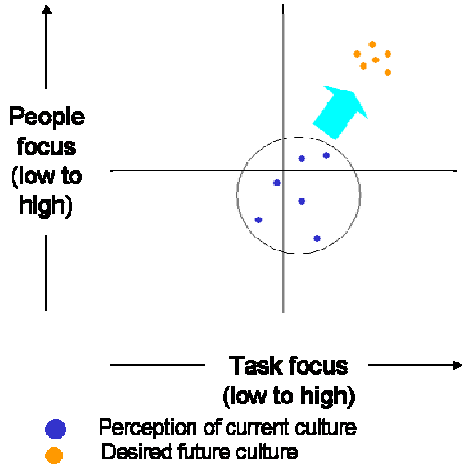

Figure 1 : Typical initial results from survey

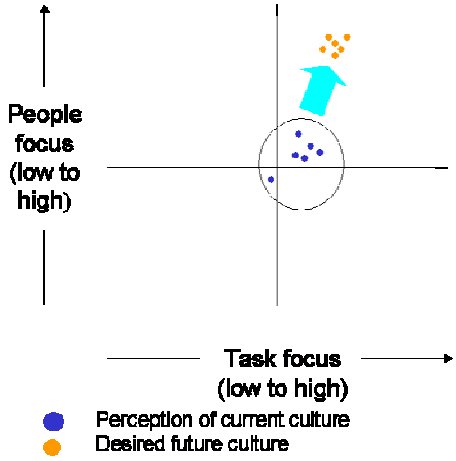

Figure 2 : Typical results after 6 months

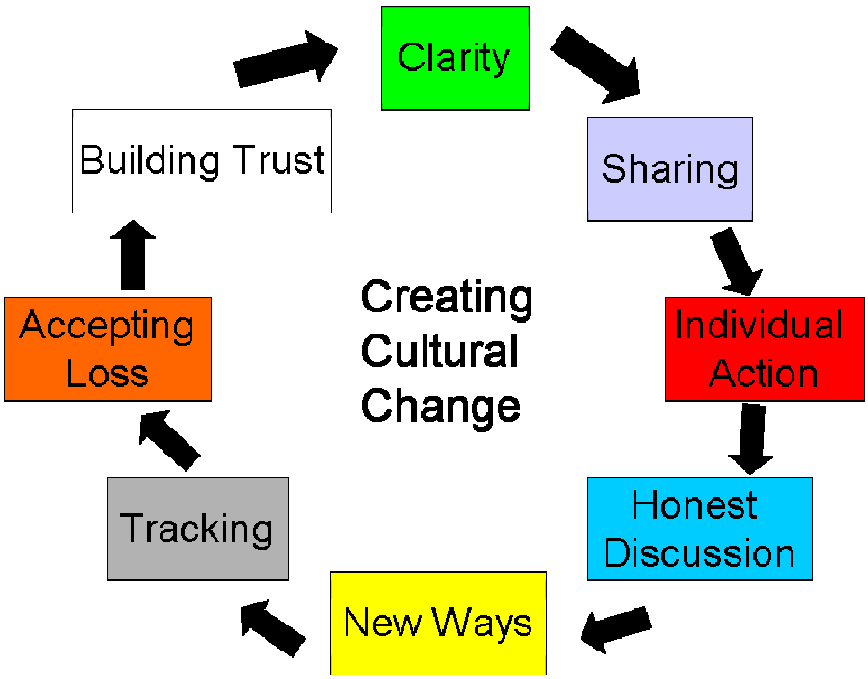

Figure 3 : Flowchart showing the model for creating cultural change

How Innovation in the Organisation of Management Systems in SMEs could contribute to the Economic Growth of Developing Countries

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Abstract: In the past, economic success of most countries depended on the performance of their greater companies. Nowadays, bearing globalisation in mind and the wide implementation of the multinational companies, the economic success of developing countries and the internationalisation of their economy depends on the performance of SMEs. However, these companies, in some countries mostly of a family scope, usually have insufficient know-how about new forms of management. Recognising that management systems are nowadays considered market qualifiers, this paper presents two ways the smaller companies can direct their efforts to production, while implementing the various management systems. Outsourcing the implementation and management of the several management systems to companies specialising in that activity is one way. The alternative is forming new companies with the same goal, but in a co-operative way amongst several small or medium sized companies operating in the same industrial sector or in close geographical proximity. The choice between alternatives for a SME depends on its sector of activity, its financial health, and applicable market qualifiers and order winners. Examples of both forms of outsourcing are discussed, and the selection criteria inherent to this decision process are discussed based on the results of a survey of Portuguese companies.

Keywords: Outsourcing, Entrepreneurship, Intrepreneurship, Innovation, Co-competition

I. Introduction

A fair amount of the economic sustainability of many underdeveloped and developing countries has been closely tied to big companies. Lower labour rates attracted many multinational companies to establish labour-intensive production operations in underdeveloped and developing countries, in the 1980s and the 1990s, and still do nowadays in many cases. Part of the economic success of such countries depends strongly on their ability to attract these kinds of production operations. There has in recent years been a change in this state of affairs, driven by the growing impact of globalization and by actual success in attaining development in some of the countries where delocalized operations moved into. Countries that were successful in attracting foreign investment, but having seen a rise in living standards, such as the case of Portugal, need to seek out and reinforce other mechanisms for sustaining economic growth. Increasing the performance of Small and Medium Enterprises, seen through their internationalization, can have a big impact on the success of the country's economy.

The relative weight of Small and Medium Enterprises (SMEs) is very big across Europe, adding up to 99% of the total number of European companies, according to Eurostat. In Portugal, SMEs are very important in the country's entrepreneurial structure. 99,6% of the total number of Portuguese companies are SMEs, offering 75% of employment and representing 58% of economic transactions. Between the years 2000 and 2003, the number of Portuguese SMEs grew at an annual rate of 9%, creating a rise in employment of 5,6% per year and a 4,3% growth of sales volume per year. This contrasts with roughly unchanged sales volumes and employment figures for the bigger companies operating in the country altogether. With an economy that is undergoing development, SMEs play a decisive role in the economic development of Portugal. However, these companies, in many cases owned and managed within a family, frequently have insufficient know-how about the new forms of management (Conway 2006). SMEs have joined certification of their management systems, namely their quality management system, for survival reasons rather than any other. Given increasingly

demanding supply chains (many of which have an international dimension), SMEs will have to follow in the steps of competitors.

II. Enterprise culture and management systems

In the recent decades, the implementation of management systems has been massive, and it is taking place through certification, based on normative documents which are internationally accepted, as is the case of the documents of the International Standards Organisation (ISO). Highlighted are the Quality Management Systems – QMS – (ISO 9000), since 1987 (revised in 1994 and in the year 2000), and the Environmental Management Systems – EMS – (ISO 14000), more recently, since 1996 (revised once, in the year 2004). Although there is yet no ISO standard in the area of Occupational Health and Safety (OHS), the OHSAS 18001 standard/specification (Occupational Health and Safety Management Systems – OHSMS), created in 1999 by an international group of organisations, including the renowned British Standards Institution (BSI), is starting to show universal acceptance.

In the greater companies, many of which are part of international groups, the culture of the various management systems is clearly rooted. On the one hand, this is so because they which to position themselves at the forefront of management excellence, and on the other, due to market competition. On the other hand, in the smaller companies, in some countries mostly consisting of family companies, there is insufficient know-how concerning the new management approaches, in areas such as quality, environment, occupational health and safety, energy, maintenance, or innovation. Since the implementation of management systems, namely in the Quality area, now takes the form of a market qualifier (Hill 1993), industrial companies should act dynamically, adapting to the new challenges. Although resources may not be as scarce in larger companies, in the smaller sized companies, the lack of resources limits their strategic options. In the vast majority, these SMEs do not possess enough resources, or competencies, to implement and to support a management system, not even the most exploited one, the Quality Management System. According to data supplied by consultant companies operating in Portugal, most SMEs using consulting services, want to implement QMSs, EMSs and OHSMSs (http://www.forum-empresarial.pt). Another fact is that those SMEs that seek more consulting services originate in the industrial sector, those noteworthy include, among others, the metallurgic and metal-mechanics sector, the cork sector, and the footwear and textile sectors.

III. Outsourcing and co-operation between SMEs

The new global economy, with increasingly fractionated production processes, and with new threats and opportunities, has forced companies to look beyond their individual strategies, placing inter-company collaboration in the agenda of the business world. This does not apply merely to bigger companies, but also to SMEs, since, especially due to survival reasons, they have to respond dynamically to constant challenges. Collaboration between companies may assume the forms of virtual collaboration (Somora et al. 2005), production processes collaboration (Lin et al. 2005), or collaboration at the level of distribution channels, among other forms. Additionally, competition through market positioning is increasing, side by side with the augmented frequency of collaboration among competitors. The dynamics of network organisation, of partnerships and collaborative enterprises are fundamental principles of organisation in the New Economy. This kind of co-competition is often placed at a regional level.

It is certain that the resources, both human and financial, are not abundant in any company, but the situation in SMEs is typically troublesome. It is preferable that these smaller sized companies dedicate their efforts – resources – to the activities for which they were designed (producing), leaving the management systems issues to another entity, namely, an entity that performs the management of their system(s). We consider two alternative ways for the smaller sized companies to dedicate their efforts to the activities for which they were designed (producing) and simultaneously implement the various management systems, separately or in an integrated way. One alternative is calling in specialised companies dedicated to the management of the various systems (Outsourcing) – this would certainly lead to the creation of

new enterprises (Entrepreneurship). The second alternative concerns the generation of new companies (co-operatives) in the scope of a group of companies ("Co-competition" – Intrepreneurship) in the same industrial sector or in close geographical proximity, with the goal of managing their management systems. For a small company, the choice between both options depends, among others, of factors such as its economical and financial situation, or applicable market qualifiers and order winners.

IV. Results of SME survey in Portugal

With the purpose of gauging the aforementioned criteria, as well as other purposes related to the industrial strategy of industrial companies, such as their needs of personnel training, a study based on a survey was carried out. A questionnaire (in Portuguese) was sent to randomly selected industrial SME companies in Portugal, resulting in 31 completed questionnaires. The assumption pointed out throughout this paper that the choice for a small company between the alternatives presented depends on its sector of activity, its financial health, and applicable market qualifiers and order winners, was verified.

Concerning market qualifiers of the 31 companies participating in the survey, the following results have been compiled:

- Product certification: 42%
- ISO 9001 certification: 35%
- E-procurement: 13%
- ISO 14001 certification: 10%
- Responsiveness and adaptability to customer demands: 9%

The respondent companies also identified their applicable order winners:

- Product quality: 81%
- Product pricing: 77%
- Delivery time: 65%
- ISO 9001 certification: 23%
- Product certification: 23%
- Quality of After-Sales service: 23%
- ISO 14001 certification: 6%

One of the questions in the questionnaire, according to the two alternatives discussed throughout the paper, had the purpose of probing if, in the case of a company, for the service of current management of a management service (e.g. Quality, Environment, or OHS), the company had to decide between an external company (a) and an inter-company co-operation (b), what would be the criteria that would inform this decision process. The following results were obtained for this question:

- Economic and Financial considerations: 71%
- Know-How (competencies): 45%
- Enough Human Resources: 32%
- Focusing on Production Activity: 26%
- Public Incentives: 16%

In sequence to the previous question, the respondents were questioned about what they saw as advantages and disadvantages of each of the alternatives considered, i.e., an external company (a) or an inter-company co-operation (b). The compilation of results for this question is shown in aggregate form in Tables 1 and 2.

Table 1. Advantages and disadvantages of resorting to an external company (a).

Advantages	Disadvantages
More economical (cost reduction)	Increased cost
Independent service	Less control over the situation
New ideas and new processes	Periodical service (lack of continuity)
Acquiring new knowledge in the area (intermediate levels of personnel)	Ignorance and adaptation of company management to the new reality
External human resources	Less internal intervening and consequent inapplicability of the system
Collaborators pay more attention to external trainers	
Management of productive timings and search for alternative means	Inadequacy to company culture

Table 2. Advantages and disadvantages of the inter-company co-operation (b).

Advantages	Disadvantages
Sharing of knowledge	Periodical service (lack of continuity)
Teamwork strength (synergies)	Increased cost
Internal efforts in system applicability	Waste of internal resources
More economical	Individual interests (superimposition of interests)
Brainstorming	All the disadvantages common to an inter-company service which is not adequate to the company's culture
Partner fidelity	

The results fall straight into what was hypothesised throughout this paper, especially the importance of factors related with human resources (including competencies) and the financial questions, which primarily affect SMEs. The results show that, in what concerns criteria that influence the choice at hand, most answers (71%) fall upon economical and financial considerations, and, about 45% concern the set of human resources and competencies. This, indeed, confirms that, in particular in SMEs, besides the lack of financial resources, it is the shortage of human resources and competencies in these areas of management systems that limits the adherence to them. The set of advantages and disadvantages unveiled by the survey for the two alternatives presented to deal with resource scarcity within SMEs shows how this decision process is informed.

Acknowledgement

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A competence based view of innovation: interaction of innovative groups

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Abstract: Succesful innovation depends on people. Often the cooperation of few people drive innovation in informal settings. It is the innovation competence of these people in a specific organizational context that makes a difference. We argue that organizations need to learn what are the basic ingredients of a competence based innovation approach.
In the paper we report about the results of a German-Swedish project, in which a model of innovation competence has been developed and partly empirically validated in German and Swedish firms. Our model is based on activity theory and defines distinctive activity levels related to innovation competence.
An internet-based self assessment of innovation competence is one of the results, which particularly might interest enterprises (www.stvg.at/kompetenz.nsf/KompetenzRahmen?OpenFrameSet).

Keywords: Innovation competence, innovative cultures and behaviours, creative routines

1. Introduction

In creating successful innovation strategies there is a tension between two different modes of learning and innovation. Jensen et al (2004) argue that on the one hand there are innovation strategies (**S**cience-**T**echnology-**I**nformation -mode of innovation) that give main emphasis to promoting R&D and creating access to explicit codified knowledge. On the other hand there are innovation strategies (**D**oing-**U**sing-**I**nteracting-mode of innovation) that are mainly based on learning by doing, using and interaction. We agree with Jensen et al (2004) that there still is a clear bias among scholars and policy makers to consider innovation processes largely as aspects connected to formal processes of R&D, especially in the science-based industries (STI-mode). In our paper, however we will concentrate on the DUI-mode as an important part of building innovation competencies of organizations.
The DUI-mode will typically involve organizational frameworks of interaction between employees (innovative groupings) and a competence based view of innovations focussing on implicit knowledge and interactive learning.

Learning in the workplace can be understood in two ways (Lantz and Friedrich 2003): either as essential to the acquisition of those vocational skills and competencies, needed for performing work activities *planned by others and given,* that are more or less complex in the sense of problem-solving; or, as a springboard for innovation change and part of an open-ended developmental process. For developing innovation competencies, a key question is to understand how employees *qualitatively reconstructs objectives.*

According to Engeström (1987), an open-ended developmental process requires individuals who – through reconstruction of the objective(s) linked to their task(s) – construct and perform *qualitatively* different work (Engeström, 1987; Friedrich, 1992; Klemola & Norros, 1997; Norros, 1990; Virkukunen, Engeström, Helle, Pihlaja & Poikela, 1997). It is through a cognitive reconstruction process that work activities are developed into more productive forms and new and more complex work activities defined, and it is via this process that learning and innovation takes place. Work activities are social and intrinsically co-operative. A certain work task can be performed individually, but it is always related to a context in which others are present. When examining learning and innovation, the individual's reconstruction of objectives and the systemic relations between the individual and others involved in the work process both need to be understood.

Frese, Fay, Hilburger, Leng and Tag (1997) and Fay and Frese (2001) present the construct of "personal initiative" as characterised by people taking an active and self-starting approach to work, going beyond what is formally required in a given job (innovative behaviour). Such proactive behaviour presupposes a reconstruction process allowing the definition of extra-role goals that have a long-term focus and lie outside role requirements. The worker translates externally given tasks into internal tasks through reconstruction, and this process allows employees to define extra-role goals (Frese, Kring, Soose & Zempel, 1996).

To bring about innovation it is relevant for employees to learn by doing, using, interacting to develop capabilities to reflect on, question and change current work processes and outcomes. The different forms of carrying-out work can be presented in a hierarchical order from reactive to proactive, change oriented behaviour. Engeström (1987) refers to Leont'ev (1978) and Bateson (1972), among others, when presenting the following hierarchical structure of activity: (1) *operations* as reactions to *conditions* in the surrounding context in the form of behavioural routines, (2) *actions* as related to *goals* in the form of problem-solving in the existing context, and (3) *activity* as related to a *motive* to bring about change through *awareness of contradictions in the present work activity*. It is this third level which is crucial for creating innovations and has not very much been focused on, neither in research or in developmental activities.

Based on the above theoretical framework **we define innovation competences as the knowledge and skills that become manifest in activities which are related to a motive to bring about change through awareness of contradictions in the present work activity.**

2. Evaluating innovation competencies: The ICA approach

Based on Mansfield (1996) the **Instrument for Competence Assessment (ICA)** by Lantz and Friedrich (2003) provides a way of obtaining a general description of the competences that employees in all types of organisations possess to varying degrees. The dimensions are described below.

1. **Functional work task:** Expectations are imposed on the individual with regard to achieving a variety of outcomes on the basis of specific function within the company. For example, being an assembler in industry may involve receiving customer orders, collecting parts, assembling parts, packing, and so on.

2. Managing contingency - Handling unexpected situations: In a modern organisation, skills demands are imposed on members at all levels with regard to discovering risks of disturbances and problems, and actively contributing to their solution.

3. Managing different work activities - To set priorities and co-ordinate: Managing different work activities involves competence in prioritising between and taking

decisions on frequently competing tasks and maintaining a balance between the long-term and short-term goals of work.

4. Natural constraints - Handling the physical circumstances of the workplace : This refers in a broad sense to where work is performed, and what material and equipment are used. The most important competence that can be developed for handling the physical environment lies in simply being aware of its significance to health, safety, and ecology.

5. Quality measures: Different quality demands are imposed in various kinds of organisations, but there is always the expectation that the outcome of work shall be of a certain quality. This requires the ability both to understand quality requirements and to realise that these may vary according to what is to be produced.

1. **6. Work organisation:** The competence lies in understanding the organisational setting's significance to work and in organising so that work performance is enhanced or expanded. This involves skill in handling the demands that the organisation imposes on the performance of work, and also in handling the degrees of freedom offered by the organisation.

7. Working relationships: In most workplaces there are a variety of different relationships both inside and outside the organisation. Having competence in handling relationships at work does not only involve maintaining and preserving relations but also developing them so that they promote effective work and are a means for goal achievement.

2.

3. Different levels of competence

By introducing different levels of competence Lantz and Friedrich (2003) have further developed the above described content of competence. An employee's competence in handling the different work areas is assessed in accordance with a four-point scale that measures cognitive complexity. The scale ranges from no competence (0) to less-to-more (1–3).

0=No task is being conducted (for various reasons).
1=The task is being conducted within the employees own work area but without any relationship to the goals of the task.
2=The task is being conducted within the employees own work area and in interaction with the work areas of other employees within his/her unit/department and in relation to given goals for the work.
3=The task is being developed as a result of the employee, in interaction with his/her own unit/department and other affected parts of the organisation, having contributed to the establishment of new goals for developing the task.

We argue that innovations are likely to happen if employees develop level 3 competences in the above areas.

3. Modelling innovation activities

Innovation activities are guided by a motive, which is the „ideologiacl" basis to inspire people to derive objectives and activities related to change**.** **Motives** can be formulated as a metaphore, e.g. to bridge gaps between optics and electronics, to be the lighthouses in a specific technology . Nonaka and Takeuchi (1995, pp. 64) argue that using an attractive metaphor is highly effective in fostering commitment to the creative process. Innovative firms succeed in creating an attractive motive to bring about change through awareness of contradictions in the present work activity

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The interaction between motive and objectives for change oriented activities characterises innovation work. A main **competence** of innovative groups is the ability **to cope with and overcome tensions** between overall enterprise goals (target orientation) and job related work goals which are object oriented). These competence needs to be learned and developed by "doing, using, interacting". Organisations which want to foster innovation have therefore to be aware to create scope for action and a conducive context. There is a significant difference if groups formulate their own objectives (decision latitude), if they can only prioritise between given objectives or only act within a given goal.

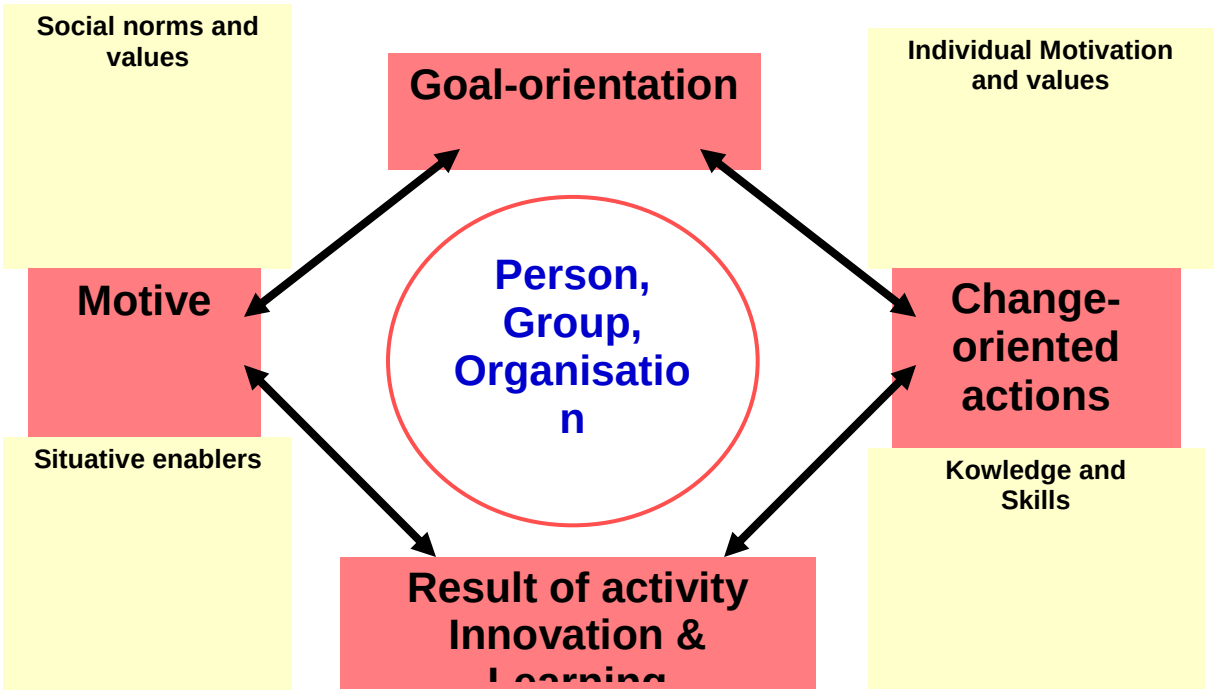
4. Innovation activities are based on an **interplay between individual, group and organisation**

Motive, objectives, and activities are „handled" on several levels in an organization. Activities are of individual nature. Forming objectives is done by the individual in an interaction with the group by interacting with those stakeholders which have power to define the motive. As innovation processes are not deterministic, innovation competence includes also the **capability to orchestrate the innovation value chain** "motive – objective – change oriented activity in an interaction between group/project team and organisation.

In order that this happens a context, which we call **innovation ecology,** needs to be shaped and nurtured. This context consists of four main domains (c. v. Rosentiel 2000) where management may act upon:

- Individual motivation and values,
- Social norms and values
- Knowledge and skills
- Situative enablers (organizational environment)

Innovation activity as selforganized process



4 Conclusion

Based on the discussion above we can conclude that the key aspects of a competence perspective on innovation are:

- Innovation = change or further development of goals. The goal construct (in relation to its importance for understanding and developing human actions) is one contribution of research in competences to innovation
- Innovation = collaborative process; the process of learning should be understood as a prerequisite (for innovation) and also as a result (the innovation itself). That means the prerequisites are the competences and the organisational solution of how to use the competences. Here the contribution from research on group work is very important.
- The decisions about the use of different competences are based on a process which coordinates the effectiveness of the relations between the different levels (person, group, organisation). Due to the openness of the goals in an innovation process there can't be a 'perfect' planning from the beginning to the end. The theoretical implications of the theory of self-organisation gives important inputs here.

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Social Psychology and the Challenge for Interdisciplinary European Research

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Abstract: European Research projects are sometimes big but not necessarily world class. Especially the expected benefits of interdisciplinarity (integrated solutions for complex problems) at times fail to materialize. Some of those projects that don't reach the promised results happen to not apply the knowledge produced by over 60 years of research and practice in social psychology. Others - using this knowledge - are faring better.

This article reviews some findings of social psychology research to the extent that they are relevant for managing interdisciplinary research projects – tracing works by Kurt Lewin, Carl Rogers, Edgar Schein and others. Subsequently, the article characterizes two case studies from the 6th Framework Programme – examples that show which activities fail to produce the hoped for benefits as well as others that seem to work better. Problems relate to fuzzy objectives, the absence of clear and shared visions, the lack of attempts to create a shared language, the absence of feedback sessions about the way the work is done, a predominant management style of control rather than support, and other problems.

The article concludes with the recommendation for the European Commission to ensure that the hard-won insights of social psychology come to bear on the leadership and management of interdisciplinary projects.

Key words: Social psychology, European interdisciplinary research, leadership and management

Introduction

When Copernicus in 1543 showed that the Earth was not the centre of the world but only a part of our solar system he not only made an important discovery that freed the way for more. He also discredited and threatened established theory and practice and forced upon science a process of relearning.

Today, parallels can be drawn from Copernicus' discovery to some of the striking advances social science - and more particularly social psychology - has made over the last seven decades: Through systematic research but also through less controlled experiences it has, among other things, fairly well established how people from various cultural backgrounds can make possible significant learning as well as action that generates constructive change.

Clearly, these insights can be beneficially used for the leadership and management[1] of multidisciplinary and multinational European research projects, especially as these projects increasingly are not only concerned with producing new insights in laboratories and for other scientists but also with the need to make practical use of the generated knowledge (Schrogl 2006, 61).

And yet, much of what has been established by social psychology in the last seventy years is ignored in at least some of these projects and maybe in many – with demonstrable drawbacks for interdisciplinary scientific production and also the effective solving of complex problems in the real world – not to mention the joint development of products that could profitably be sold and thus generate employment.

[1] Leadership is seen here as any action that provides effective guidance and motivation; management as those actions that contribute to the effective use of resources. The two notions are interlinked.

My hypothesis is that those interdisciplinary research projects that largely ignore the relevant insights of social psychology will fail. Contrary to this, those projects that skilfully heed these insights are more likely to reach their objectives of finding applicable solutions for complex scientific and practical problems.

This article will illustrate the hypothesis in a case study and thus provide some (of course limited) evidence to support it. By doing so, I am hoping to realize the following purposes:

- Reiterate some neglected insights from social psychology that can beneficially be used for interdisciplinary research projects in Europe.
- Show with the case study of European Research projects what happens when these insights are not or only partially used by project leadership on various levels.
- By doing so, make the case for taking a fresh look at social psychology and for integrating its insights more systematically into European research.

The article will first explain the term social psychology and the associated heritage of Kurt Lewin. It will then shortly introduce three current approaches in social psychology that can be seen as related to this heritage. After that, the two European Commission financed research projects that provide the basis for the case study will be outlined. Next, various typical challenges in such projects will be discussed. Then, some findings of social psychology that pertain to project leadership and management on its various levels will be presented together with examples of what happens in research reality. The article concludes with a few recommendations of how social psychology can be more fruitfully applied.

A brief background to Kurt Lewin and social psychology

Kurt Lewin (1890-1947), a German immigrant to the United States is considered “one of the most creative and controversial figures in the history of psychology” with a lasting legacy in contemporary social psychology (VandenBos 1997, v). He fused the two disciplines of sociology and psychology intending to study “social facts” as explanatory factors for the behaviour of individuals and groups of all sizes.

Social facts are “forces” that influence the behaviour of individuals, groups and organizations. These forces, according to Lewin, are usually diverse, dynamic and interdependent and might include issues such as the personal values of individuals, group structure (e.g. problems of hierarchy), the personality of individuals in the group and their behaviour (including leadership), as well as any other fact that might bear on group dynamics, such as the health of a group member, or the place where a meeting is held (Lewin 1939a, 264). Relevant social facts exist within the group/ organization but also in its environment.

Together, social facts create a complex field of forces that the social psychologist has to know in detail and also to understand as a whole in order to be able to make any prediction of what is going to happen in the group. Says Lewin: “Whether or not a certain type of behaviour occurs depends not on the presence of absence of one fact or a number of facts as viewed in isolation but upon the constellation (structure and forces) of the specific field as a whole” (1939a, 275).

Lewin did extensive empirical research on groups and used his insights to develop theories – some of which are of use today largely in their original form such as his force field analysis and his theory on how change happens in groups and organizations (Schein 1996).

Of lasting importance is his contention – that he confirmed by his research and theory building – that constructive and destructive behaviour in groups can be studied and that conclusions can be drawn with regard to how groups and organizations should be led if learning, motivation and change impact are desired.

Social Psychology as used for this article

Much has been written and has happened in the field of social psychology since Lewin's death. (For partial overviews see Argyris 1993, 15-48 and Schein 1996). In this paper, I will make an arbitrary selection of three streams that appear particularly relevant for the above-mentioned objectives of this paper.

1) *Process consultation*: The term is Edgar Schein's (1987) from the Sloan School of Management at MIT. The approach is directly in the legacy of Lewin's work, explicitly picking up his theories and developing them further mostly focusing on questions of organizational change. Other theorists-practitioners in this field, though by no means the only ones, are Chris Argyris (e.g. 1993) from Harvard Business School and Klaus Doppler (e.g. Doppler and Lauterburg 2000), the editor of the journal *Organisationsentwicklung* (organization development).
2) *Group process facilitation*: This approach is focusing mostly on situations of group meetings asking what interventions – if any – can make them more effective. Special consideration goes to meetings and workshops with participants from a variety of backgrounds, views and perspectives (see for example Kaner 1996; Spencer 1989; Stanfield 2000). The approach is so useful because it discusses the very details of communication and learning situations and how to constructively deal with them. In many regards, process facilitation is the practical application of the empirical findings of social psychology.
3) *The person-centred approach/ humanistic psychology:* The founding figure is Carl Rogers (1902-1987), called by his biographer: "America's most influential counsellor and psychotherapist – and one of its most prominent psychologists" (Kirschenbaum 2004, 116). In fact, Rogers is probably more adequately seen as the initiator of a new and important trend in the social sciences - humanistic psychology - rather than an heir of Lewin. His work is nevertheless summarized here under the title of social psychology because thematically Rogers was not far from Lewin, being concerned with setting up an environment that best enables change and problem solving for individuals and groups (e.g. Rogers 1961). Like the work of Lewin, Schein and others, this approach is confirmed through rigorous research.

The case study: two European Commission-funded interdisciplinary projects

I am using as a case study two projects funded in the 6th Framework Programme (FP6) of the European Commission for research and technological development. I had the opportunity to receive considerable information about the first two years of these two projects and I will draw on this information in the following. I am naming the projects here FP-T (for rather traditional leadership style) and FP-M (for a more malleable leadership style). My knowledge is more detailed on FP-T than on FP-M, therefore I will focus more strongly on the former.

FP-T and FP-M are both funded with more than 8 million Euros and include over 30 mostly research institutions (and a few private enterprises) each. The projects each involve more than 60 researchers from more than a ten different countries and from scientific disciplines ranging from civil engineering via agronomy to political science and psychology. More than five European and non-European case study test sites in each project serve to apply and generate knowledge locally.

Both projects want to bring about palpable change as they set out to address complex environmental problem situations interdisciplinarily and by involving local stakeholders. More specifically and among other outcomes, the interdisciplinary integration and the inclusion of stakeholders is to bring about real change locally but also on a European scale with regard to how certain environmental issues are handled (FP-T a; FP-M a).

From my information about the projects it is clear that project leaders and coordinators are facing specific challenges even before the projects have started:

The (possibly typical) challenges of European interdisciplinary projects

- The most obvious challenge lies in the variety of scientific disciplines. Each discipline has developed its own language (though often does not even internally always agree on certain terms). Understanding the concepts of only one other discipline requires first of all interest (and not seldom the overcoming of prejudice) but then also time.
- The second obvious challenge is the diversity in national cultures. That the French, Italians and the Spanish drink wine with their lunch but the Dutch prefer butter milk is possibly not very grave, but fluid concepts of time in one culture might be seen as "ineffective" in another. And senior male researchers from Greece might have quite different views on the meaning of project hierarchy than female PhD students from Germany.
- Unlike in more traditional project and management situations members are geographically scattered. This makes building relationships even more challenging. Also problem solving "by the coffee machine" is obviously not frequently possible.

There are less obvious challenges also, but they are very tangible to project managers:

- A work overload of maybe most researchers: Typically, project partners work in various projects in parallel, have to report, coordinate, publish (or finish their PhDs) and fulfil the administrative demands of their own organizations. To always meet all requirements of any given project on time might simply be too much.
- An existence of established research priorities prior to the start of any project: Projects have their objectives, but researchers and institutions also have theirs. These objectives do not automatically match, even when it was the project partners who co-constructed the objectives of the project. In the case of FP-T and FT-M, many researchers were already pursuing specific smaller scale research projects, prior to the start, and not necessarily interdisciplinary ones. FP-T and FP-M, in the mind of some researchers, then provided funds to continue these studies but not necessarily to integrate them with others. Also quite a few researchers tried to initiate new non-interdisciplinary work with the funds of the project in their own research areas. The challenge for the coordinators thus is to see how these interests can be integrated into the objectives of the project.
- Interpersonal issues: In big projects there are often researchers together who were together in previous projects – having established trust or mutual dislike. In the latter case their relational situation may come into the project as a burden. Depending on the degree of conflict – from disagreement on scientific matters to overt antipathy – cooperation becomes difficult.
- The lack of client-orientation among many (though not all) researchers: Many researchers seem to primarily be eager to get the data they need for their research, to publish and then start the next research. This might seem legitimate. However, the interest of the mentioned projects is to constructively work with stakeholders, solve problems and bring about change. To illustrate the issue: One case study site coordinator told me that she was surprised that stakeholders stayed kind to researchers after they had been asked "the same questions for the fifth time" (by various researchers). And another researcher had the impression that environmental managers sometimes seemed to merely tolerate researchers at their meetings rather than to expect anything from them.
- A lack of experience with successfully managing the complex tasks of interdisciplinary cooperation and stakeholder-oriented problem solving at all coordination levels of the projects: This is not to say that all coordinators on the various levels of the two projects lack this experience. On the contrary some are very experienced. But it needs more than a few people. This is obvious from what is happening in the projects (see below). Sometimes it seems to be assumed that researchers are automatically good leaders and managers. This, however, is clearly not the case because the required training is quite different.

These challenges show that coordinating a big interdisciplinary project is a major task.

The record of the projects so far

According to official project reviews that were carried out about 16 months into the projects, both then had a mixed record in handling the challenges. With regard to FP-T the review said that the project had generally well performed and solved problems in a creative way and that a lot of work was carried

out (FP-T b). On the other hand, the review also listed many and significant problems. These problems clearly persisted and possibly grew as the leadership group (the different work block[2] leaders) of FP-T in month 22 of the project, summarized them in sharper words than the external reviewers:

- Project partners did not agree yet on a common vision of what they want to achieve at the end of the project;
- Many of the project deliverables came in late and in a poor quality
- Some interdisciplinary teams that work in the test sites do in fact not collaborate (FP-T c).

This indicates that researchers have not really been communicating on a project but also not always on a test site level, and that interdisciplinary problem solving does not take place in some of the sites. Also, the necessary work is not done in the time and quality required.

According to the external reviewers, these shortcomings were not related to a lack of partner commitment or ineffective forms of collaboration but to an underestimation of complexity (especially with regard to test site work) when the project was planned and to the fact that most partners generally did not know each other well then (FP-T b). While these reasons need to be acknowledged, they do not seem to explain the mentioned problems fully, especially not when two years into the project. As I will show below, certain leadership and management practices used in FP-T were related to more or less effective collaboration and also to the motivation of participants. It is here, where significant explanations have to be sought.

FP-M received a more positive external review than FP-T especially with regard to reaching its objectives in the reporting period and also with regard to the quality of collaboration of partners.[3] (FP-M b) Problems were also mentioned but they relate more to items of secondary importance such as forms and content of reporting, though the fact that some partners did not contribute much was also mentioned. As one positive factor for collaboration, the reviewers stated that many FP-M researchers did collaborate previously (FP-M b). However, and as will be mentioned in the following section, the leadership and management practices are also different from FP-T. Again, this should be considered as an important additional explanation why objectives are reached and collaboration proceeds more smoothly.

Social psychology factors that influence project performance

1. Feedback on issues that involve embarrassment or threat

Huge projects like FP-M or FP-T need to learn about themselves if they want to improve - this seems almost too trivial to state. And to an extent they do: the above-quoted statement of the leadership group on FP-T difficulties (see beginning of previous section) is an important feedback item. Also the FP-M leadership group regularly reflected on how the project was working. So there was a degree of introspection.

But how far did the analyses go? And were the essential causes addressed and changed? For certain essential issues they were not, as the following examples will show:

A PhD student in FP-M requested data across work blocks directly from a senior researcher. His negative reaction made her think that he might have a completely different sense of “proper” communication lines. The issue – important because it involves data flow - was not further pursued between them.

A senior project partner tried to bring an issue dealing with the definition of project objectives on the agenda of the FP-T leadership group. In that part of the meeting, several group members preferred to discuss other issues in the corridor. Neither project leadership nor the project partner tried to question this behaviour in the meeting.

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[2] Work packages are smaller project coordination units, involving typically not more than two or three researchers. They are grouped into “work blocks” that on average comprise around five work packages.

[3] Reaching of objectives in the reporting period and effective partner collaboration was considered “partially [achieved]” for FP-T and achieved for FP-M.

At least two work block leaders who had dropped out of their functions in FP-T in private mentioned strong dissatisfaction about how some issues were handled. To my knowledge, the reasons for their stepping down were never openly addressed in the "official" project (and there is no record in project minutes about this).

Similar situations could be mentioned. Following Argyris (1993), they have two features in common. First, they involve negative feelings (anger, disappointment, fear etc.), which are not acknowledged - at least not openly. This "bypassing" of the negative feelings is then covered up, that is, the individuals pretend officially that the negative feeling has never occurred. Second, individuals use this strategy because the situations are perceived as "embarrassing or threatening". This again is due to the desire to avoid loss of face for oneself but also for the other side involved. Argyris and colleagues could show that this mechanism of bypass and cover-up exists cross-culturally, though the actual behaviour of how this is done varies (mentioned in Argyris 1993, 51).

The behaviour is empirically associated with avoidance of essential learning and – unsurprisingly - with a loss of performance improvement and a reduction of motivation. It also invites potential disaster as Argyris can show with the dynamics that led to the explosion of the Challenger space shuttle. (1993, 41 and 45; also Schein 2004, 396).

In FP-T, constructive personal feedback is not systematically sought despite the significant problems mentioned above. The existence of strong "defensive routines" (Argyris) is indicated by the fact that many of the involved researchers agree that items which might involve a loss of face for those involved are discussed in private but usually not mentioned officially.

In FP-M, on the other hand, even though certainly not everything is "put on the table", the overall situation appears more relaxed. For example, in one meeting the coordinator invited a feedback session, facilitated by another person than herself, on the preceding workshop for which she had been responsible. Participants did mention personal needs for example for different session styles.

2. Safe space for providing feedback

Clearly, not every psychological environment invites feedback. Several of the big FP-T meetings took place in large lecture rooms, with the senior people at least at the beginning sitting on a podium in the front. Despite occasional break-out times in smaller groups, much of the meetings was taken up by PowerPoint presentations - not unlike most "scientific" encounters.

In these circumstances it is rather difficult and maybe counterproductive to offer constructive personal feedback. And yet this feedback can be provided, but it is facilitated by a specific environment.

Carl Rogers, who has done extensive empirical research (see for example Rogers 1961; and 1978) on the kind of environment that allows individuals maximum amounts of openness, trust and frankness has identified three principal factors:

"One is the willingness to 'indwell' in the perceived reality of the other; a willingness to step into his or her private world and perceive it as if it were one's own. The more such profound understanding occurs, the more tensions relax, fresh insights occur, and communication becomes possible. Another facilitating attitude is the valuing and respecting and caring for the other person. The more this exists, the more the individual gains in self-esteem, and hence in a more responsible and responsive stance toward others. Finally, realness and absence of façade in one party draws out realness in the other and genuine meeting (to use Buber's term) becomes possible." (1978, 139).

If this sounds quite simple (and maybe simplistic), anyone who genuinely tries to apply Rogers' insight, will see the huge challenge quickly. Clearly, the ability to practice the recommended behaviour cannot be learned overnight.[4] For many, maybe most, researchers involved in interdisciplinary (and other) projects there is a vast field of learning here. And as this almost certainly implies personal

[4] Rogers and Marshall B. Rosenberg (for example 2005) have shown in much detail what is involved and how these attitudes can be learned and practiced successfully and across cultures.

change, it is possibly not very appealing to too many individuals either. And yet, if one is seriously interested in achieving better work results one would be ill-advised to neglect Rogers' insights.[5]

By honing these attitudes and practices, project leaders (on all levels) would not only allow participants to open up on critical behavioural issues. They are also likely to stimulate motivation and creativity (compare Rogers 1961, 355; also Lewin 1939b). Considering that the two big projects were also much concerned with developing innovative concepts and products such an environment clearly would be of relevance to them.

3. Releasing of control – gaining of influence

A point that naturally follows from and extends Rogers' first two attitudes of empathy and positive regard is that it will usually strengthen people's commitment to a project if they are invited to co-construct it and to co-decide on how it is to be carried out.

"The whole natural sense of one's own worth, as well as the basic need to mark oneself out and have a share in arranging matters, operate against simple acceptance of a 'ready-made product" (Doppler and Lauterburg 2000, 50).

To be sure, participation in project construction and decision making is not always a necessary factor for motivation. There are many examples of enthusiastic followers of autocrats and also of economic growth and development under authoritarian conditions.[6]

However, there are at least four reasons that militate against using this observation as a justification for project conditions that involve rather limited participation:

- In a European context this is normatively undesirable, especially in research projects that are striving to include the participation of the public.
- Beside the contradicting example of motivated followers in an authoritarian setting, significant research[7] and observation of practical experience[8] show that organizational leaders who are not especially charismatic (few are) and do not take into consideration individual needs are likely to face "implementation [that] will be half-hearted at best, probably misunderstood, and more likely than not, fail." (Doyle 1996, vii).
- The same and other research states that responsiveness to followers and relinquishing of control approaches usually generate higher performances in project partners.[9]
- According to the empirical work of Lewin (1939b) and the hypotheses and findings of Rogers (1961, 356; 1978, 100) it is very likely that creativity cannot flourish under autocratic conditions but instead needs psychological safety.

Of course, this kind of wisdom seems to at least partially have taken hold in Europeans research project descriptions, as for example in FP-T, which states that the project management style will invite participation of partners and that the research to be carried out will be stakeholder-oriented (FP-T a).

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[5] Doppler and Lauterburg re-state Rogers' insights in different form and call them "strategic factors for [the organization's] success" (2000, 191).

[6] This might have to do with the importance of charisma in leadership (see for example Howell and Avolio 1993), and with the importance of the capacity of individuals - even in certain autocratic conditions - to set and pursue their own goals – such as an increase of personal income (compare Lewin 1942).

[7] Rensi Likert already in the 1950s investigated high and low performing managers in more than 5000 organizations. He found among other things that the "high producers allowed their sub-ordinates to participate in decisions. The low-producers were very autocratic." And "[t]he high producers were good delegators; the low producers were not" (summary of his research cited in Rogers, 1978, 97). Howell and Avolio (1993) found that leaders' individual consideration of followers is associated with effectiveness. Also Schein states that: "we have overwhelming evidence that new solutions are more likely to be adopted if the members of the organization have been involved in the learning process" (Schein 2004, 395).

[8] Doppler/Lauterburg 2000, 50. See also Schein 1987, 22 and Rogers 1978, 186.

[9] Beside the previously quoted research Beierle and Cayford (2002) carried out a survey on 239 cases of public participation in environmental decision-making in the United States over the previous 30 years. They conclude that "the correlation between responsiveness of the lead agency [towards the needs of the public] and success is high, positive and statistically significant." (50). And: "the relationship between success and the degree of public control is low but positive and statistically significant" (53).

In reality, however, the two projects considered here had a mixed record to ensure research partner participation within the project and also of stakeholders into the project. On the one hand, stakeholders were given a voice on project level and in test sites in both projects. In some sites of both projects stakeholders were asked for their needs in detail. Some work block leaders in FP-T persisted in asking project partners for their needs and in trying to take them into account. In FP-M the project manager attempted to include the wishes of the many project partners into the complex agendas of the General Assemblies. The project leader of FP-M delegated feedback rounds on sessions she had been sharing to other facilitators and thus demonstrated an effective relinquishing of control. Other points could be mentioned for both projects.

On the other hand, the following behaviour could also be observed: One work block leader in FP-T first responded positively to the proposition of a project partner and then de facto ignored it for implementation. A senior FP-T project manager in a regular project meeting repeatedly verbally interrupted the statements of project partners and spoke instead at length by himself. A major FP-T project meeting was started with the message that it was important for partners to do their reporting (clearly not their need but a need of the individual who announced this). In an FP-T decision-making situation involving budgets, consensus was assumed by the meeting leader (nobody contested his proposal) but not tested for example by a vote.

The challenge from social psychology for project leaders on all levels is to learn the paradox observed by Rogers (1978, 90-104) that in many cases the use of control strategies will reduce one's influence because it will de-motivate project partners to carry out their work. On the other hand the reduction of control – together with other constructive leadership behaviour as described in the two previous and also in the two next sections – is likely to increase influence, motivation and performance.[10]

To bring this insight alive in practice, no clear-cut strategy is available that would fit onto all situations.[11] The key is to be aware of the needs of those that are involved and not to be afraid to genuinely consider them and to act accordingly. This might or might not involve the delegation of power such as in agenda setting (content and process), length of talk, meeting leadership, making available budgets, genuine testing of consensus and others.

4. Some essential process steps in interdisciplinary research projects

The findings of the previous three sections imply to integrate certain process steps into the project as a whole and also into specific project meetings if performance is to be high.

- Feedback sessions should be done at least whenever partners perceive defensive routines.
- The creation of a safe space (or the lack thereof) is affected by almost every speech act of a project leader
- Individual needs of participants should be elaborated from the beginning. As they develop and as people become more open over time – provided a safe environment – this needs to be a repeated activity.
- Leaders should check if there are interested individuals who want to take responsibility for certain aspects of the project and see if and how it is possible to co-construct or delegate.

In the two interdisciplinary projects mentioned here, especially the first two of these steps were not systematically done, but in FP-M more often than in FP-T. Also the forth step seems to happen more frequently in FP-M than in FP-T. The third one is usually carried out with regard to research interests of individual researchers, but more rarely with regard to meeting set ups or joint activities of researchers outside the regular meetings.

Beside these steps, others seem to be required for interdisciplinary research to succeed.

- The definition of a thematically and geographically specific research area that contains a problem to solve which is worthwhile to be addressed by various disciplines together.

[10] This seems also to be confirmed by the research from Beierle and Cayford (2002, 53) mentioned earlier.
[11] One would be ill-advised to use lengthy participatory processes in emergency situations for example. Also one cannot impose participatory processes (a contradiction in terms) against the will of local leadership in a specific location.

Logic demands that in order to work on a specific environmental problem it is necessary to define its exact location and the related questions to be addressed. 23 months into the FP-T project, researchers in most test sites had not agreed on specific issues that they wanted to address together, that is, inter-disciplinarily. In fact, most test site coordinators had never asked them to do so. With some exceptions, it was not clear yet how the work of economists, hydrologists, and sociologists would come together. Often they seemed to focus on quite different problems and sometimes even on different locations and partners, which were only connected on an abstract level. The problem existed also in at least one site in FP-M.

- Lead an ongoing interdisciplinary and genuine dialogue

Much lack of cooperation seems to be due to a lack of mutual understanding. While it is generally accepted in social psychology that it is impossible to work with each other, if there is no shared meaning of main concepts (Doppler and Lauterburg 2000, 229; Rogers 1961, 336), the required work was not done in most cases in FP-T – neither on a project nor on a test site level. For example after two years, basic terms that in part defined the project had not yet been fully discussed and understood.

Instead, in FP-T meetings, typically a lot of information was provided, often in the form of PowerPoint presentations, but little or no time was allocated for inquiring how each affected partner understood the information.

- An interdisciplinary vision

In FP-T it took almost two years before, besides the general objectives in the project description, more specific goals were formulated on a project level. And even these goals had not yet received the input of the majority of project partners. In the test sites the situation was similar: There simply were no visions to be reached that could have been drawn up interdisciplinarily two years into the project. It is difficult to imagine how under these conditions interdisciplinary work can get started and energized. Lewin already recognized in 1942: “a time perspective guided by worthwhile goals is one of the elements of high morale” (89).

5. Professional group process facilitation

One might ask: How can all these various steps and attitudes be practiced? Does it not take too much time to do interdisciplinary problem definition, dialogue and visioning as well as feedback sessions?

One answer is that it is also possible to start a journey without concrete and agreed goals, without a specific map, and with fellow travellers most of whom one does not attempt to understand until the end of the journey. This might indeed be “faster” but without doubt also less constructive, especially if one had the idea to arrive at the destination together. The results of the FP-T project after 24 months show what will happen, when essential knowledge of social psychology is not systematically applied.

Another answer is that there already is an applied body of knowledge which permits to transmit the mentioned attitudes and process steps in the fastest possible way into meetings, workshops, conferences and projects at large. This approach is group process facilitation.

Group process facilitation can be described as an approach to work with groups in which the facilitator out of a position of neutrality on the problem under consideration supports the group to do their best thinking and at the same time build relationships. She does this by handling the process (how people are interacting) including the skilful addressing of potentially embarrassing issues if needed. In this sense, facilitation applies in a practical way much of the empirical findings of social psychology.

The relevant manuals on facilitation contain the necessary steps that need to be taken, for example to lead a group dialogue (Kaner 1996), a brainstorming session (Spencer 1989), support the group with visual aids (PinPoint 2002), or organize feedback rounds (Stanfield 2000). One of the pioneers of facilitation states that it is “one of those ideas that simply works. As an approach to running meetings, it has been applied in almost every conceivable situation around the world.” (Straus 2002, 127).

In FP-T, professional facilitation (as embodied by somebody who is an accredited facilitator or at least has properly practiced the respective attitudes and methods for several years) was never used on a project level, rarely on a work block coordination level and very rarely in the test sites. In FP-M a facilitator was regularly used to support the General Assemblies. Professional facilitation was used in several test sites, in at least one of them constantly.

Summary and conclusion

This article has put forward the hypothesis that multidisciplinary European research projects that neglect essential insights of social psychology will fail and that those who heed the insights will fare much better.

Social psychology was briefly introduced with its founder Kurt Lewin and three current streams in the field – process consultation, process facilitation and Rogers' person-centred approach.

To illustrate the hypothesis, the article has mainly focused on two rather big interdisciplinary projects with a stronger focus on FP-T than on FP-M due to my own knowledge. FP-T, despite the various mentioned positive features, in its own words suffered from a lack of quantity and quality of its work but also and especially from a lack of integration of the various disciplines. At the same time, it could be shown that FP-T was on various project levels lacking in the implementation of many essential insights of social psychology. Notable is a deficit in providing frank but constructive feedback on various levels; the absence of safe space at many project meetings; all too often a focus on personal control on important decision-making items; a deficit in interdisciplinary problem definitions, visioning and dialogue; and a lack of using practitioners of social psychology – facilitators. All this makes uncertain the reaching of "big" goals such as producing change in environmental policy on a European level but also more specific ones such as producing creative innovations that would be competitive on the market.

The FP-M project, which appears more successful than FP-T in terms of reaching objectives and partner collaboration, did put into place more of the insights of social psychology: it used professional facilitation on a regular basis in large project meetings as well as in some test sites, significant feedback was invited at least occasionally, and the opinion of partners – even when not in the leadership group – was sought on important issues such as the setting of the agendas of the general assemblies. Nevertheless, at least one and maybe more test sites also suffered from the syndrome of the various scientific disciplines working only in parallel and not together as no specific joint problems seem to have been set and no common visions established.

The latter phenomenon – the frequent absence of real interdisciplinarity – is something which also happens in other EU-funded research projects according to conversations that I had with involved researchers. This phenomenon must be alarming to the European Commission considering its attempts to further "excellence" in the European research landscape.[12]

The difficult a priori conditions of – especially big – multidisciplinary research projects have been mentioned and can explain some but not all of the problems: the time and interest required to understand other disciplines, the diversity of national cultures, the geographical dispersion, the work overload of many researchers, pre-established and diversified research interests, sometimes conflicting relationships from the outset, the lack of client and practical problem-solving orientation among many researchers and an absence of knowledge – among many of those in coordination positions – of how to handle these challenges.

This last point makes evident: What is needed is a personal qualification of project coordinators on all levels (project, work blocks, test sites) to enable interdisciplinary research. Thus the required knowledge is not necessarily advanced research in a specific field though this in itself will do no harm. Rather, the leaders should have a proven track record in enabling researchers from very diverse backgrounds and multiple interests to get into a dialogue with each other about problems worthy to be

[12] See for example http://ec.europa.eu/yourvoice/results/research/future_fp7.pdf

solved by them together and in motivating them to address these problems. They should also not be shy to ask professional facilitators to help with meetings and overall project process.

It would certainly be worthwhile to look at other relevant projects and see how interdisciplinarity is working in those and what leadership and management approaches are used. Considering, however, that the mentioned studies in social psychology have already looked at a great diversity of organizational situations I expect that the hypothesis, as put forward in this article, holds.

More work should be done however, to include other studies on interdisciplinarity. In addition, more social psychology insights than could be discussed here deserve close attention. These include but are not limited to Lewin's force field analysis, his complete change theory, action research (all in Lewin 1997), the empirical study of effective leadership (e.g. Howell and Avolio 1993), the emergence of culture on organizations (Schein 2004) as well as theories and empirical findings on learning (e.g. Argyris 1993).

In addition, more practical experience should be gained with how exactly the insights of social psychology can be applied in practice, considering that they imply difficult personal adjustments in many cases. The most effective way – social psychology is also clear on this matter (e.g. Argyris 1993) - would be to gain these experiences in a practical and applied way and keep track of this. Researchers should be encouraged to try out the practice of these insights during their projects, possibly with experienced facilitators accompanying them, and helping them reflect on their experience and keep track of their learning. It is also on this level that a fruitful interdisciplinarity can be groomed between the natural and the social sciences.

That this is possible – provided that there is the political will - show experiences from Lewin's country of choice, the US. School teachers, for example, have their colleagues observe them during class time and give them feedback on issues such as their treatment of students (Söhn 2007, 74). And for decades, American university students have presented anonymous feedback to their instructors.

Lewin, Jewish, chose to leave Germany when Hitler took power in 1933. Since, Europe has overcome fascism politically. But is it ready to learn from the minds that it once lost and make another step towards excellence and also towards a more humane science?

Only when the management practice of interdisciplinary projects has changed, the new Copernican revolution will have happened. Like in Copernicus' time unlearning of old scientific perspectives and practice will be painful. On the other hand, it also opens exciting perspectives of personal development and higher overall performance. Those who choose to not follow it, risk to not even understand why their interdisciplinary projects are failing.

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Complementarities between Innovative Activities in Knowledge-Intensive Based Service Firms: Evidence from the Statistics Canada Innovation Survey in Services

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Abstract: A Multivariate Probit model is estimated in order to take into account the fact that KIBS firms simultaneously accomplish many innovative activities. Positive significant correlations between equations suggest that various innovative activities are complementary whereas negative correlations imply that innovative activities are substitutes.

Keywords: Innovative activities, complementarities, substitution, knowledge-intensive based service firms

I. Introduction

The aim of this paper is two-fold. First, complementarities and substitutions between various types of innovation activities are studied in order to see how KIBS firms mix different types of innovation activities to develop or improve their goods and services. Secondly, we explore heterogeneities in the determinants of KIBS firms to choose between six types of innovation activities related to the development and improvement of goods and services.

II. Contribution of the paper

The development and/or introduction of new or significantly improved goods and services result from new combinations of knowledge embodied in people, and knowledge embodied in equipment and machinery. In spite of a vast literature on innovation and its determinants, prior studies on innovation activities have focused the attention on R&D. The other innovation activities and the question of how firms mix different innovation activities have received much less attention. This paper aims to fill this gap by looking at a sample of knowledge-intensive based service firms operating in engineering consulting services, computer system design and management consulting services in order to shed light on how they mix six innovation activities to develop and or improve their goods and services.

While prior studies have examined the determinants of innovation activities in separate models, this paper uses a Multivariate Probit model to reflect the fact that in practice, firms simultaneously consider the contribution of different innovation activities. The Multivariate Probit model includes six equations estimating six innovation activities: internal R&D, external R&D, acquisition of equipment and machinery, acquisition of other external knowledge, training, and marketing activities of innovations. The explanatory variables included in the Multivariate Probit model are the following: knowledge employees, knowledge management practices, knowledge development practices, niche strategy, risk aversion, regulation and standard obstacles, organizational rigidities within the firm, government support, protection of intellectual property, size of firms, and subsidiary firm or not. The results show that there are many differences in the determinants associated with the different types of innovation activities.

III. Data

The data used in this study are the responses of 2625 innovative service firms to the 2003 Statistics Canada Innovation Survey on services. This survey was carried out by Statistics Canada according to the methodological guidelines developed in the OECD'S Oslo Manual (OECD, 1992, 1997). The sample unit comprises firms with at least 15 employees and at least $250000 in revenues. The respondents were the CEOs or senior managers at the firms. The survey was mailed out on September 15, 2003 and data collection closed on January 30, 2004. The response rate amounts to 70.5% of the population of firms. Adjusted weights of respondents were computed by Statistics Canada methodologists to represent non-

respondents. The data analyzed in this paper cover only innovative service firms operating in engineering services (n = 627 firms), computer system design (n =1514 firms) and management consulting services (n = 484 firms). Methodological issues and the overall description of the survey are presented in Lonmo (2005).

IV. The determinants of firms' choice innovative activities

To the extent of our knowledge, the Multivariate Probit model approach to data analysis has never been used to address the issue of how knowledge-intensive based service firms combine different types of innovation activities. The multivariate probit specification allows for systematic correlations between choices for the different types of innovation activities. Such correlations may be due to complementarities (positive correlation) or substitution (negative correlation) between these strategies. The multivariate Probit model used in this study consists of six binary choice equations. These choices are for the innovative activities undertaken by Canadian knowledge-intensive service firms operating in three sectors, namely: Engineering Services, Computer System Design Services and Management Consulting Services. The six innovative activities refer to: internal R&D linked to new or significantly improved products (goods or services) or processes, external R&D activities which are R&D activities performed by other firms or organizations, acquisition of equipment and machinery specifically purchased to implement new or significantly improved products (goods or services) or processes, acquisition of other external knowledge such as patents, non-patented inventions, licenses, know-how, trademarks, software and other types of knowledge from others for the development of new or significantly improved products (services or goods) and processes, internal or external training for your personnel directly aimed at the development and /or introduction of new or significantly improved products (goods or services or processes), and internal or external marketing activities directly aimed at the development and /or introduction of new or significantly improved products (goods or services or processes). The dependent variables of our model are six binary variables referring to six innovative activities that KIBS firms can initiate. Each variable is equal to one if, between 2001 and 2003, the firm has accomplished the innovative activity and 0 otherwise.

The goodness of fit of the multivariate probit model is firstly assessed using McFadden R^2 (Oude Lansink et al., 2003; Veall and Zimmerman, 1996)[1]. A value of 0.17 is found which is quite low, but remains reasonable for qualitative dependent variable models[2]. A second assessment of the quality of the model fit is given by the first reported Likelihood Ratio Index (LR $index_1$) which compares the Log Likelihoods' values related to the unrestricted model and to the ''naïve'' model containing only an intercept for each of the eight equations. The computed value of this first index is much larger than the critical value of the chi-squared statistic with 84 degrees of freedom at the 1 percent level. This suggests that the null hypothesis, that all the parameter coefficients (except the intercepts) are all zeros, is strongly rejected. Consequently, our model is significant at the 1 percent level. The second reported Likelihood Ratio Index (LR $index_2$) compares the Log Likelihoods' values related to the unrestricted model and to the model forcing the correlations between the equations' disturbances to be equal to zero. The computed value of this index is much larger than the critical value of the chi-squared statistic with 15 degrees of freedom at the 1 percent level. This suggests that the null hypothesis, that all the correlation coefficients between the equations' disturbances are all zeros, is strongly rejected. Consequently, the use of the Multivariate Probit model to estimate our system of the six equations explaining the innovative activities included in this study is appropriate. This last result provides evidence, at least for our data, that the use of the separate standard Probit models is not adapted to estimate the determinant of the choice of the firms' innovative activities portfolio. Indeed, the resulting estimators from the standard approach would be inefficient. The last Likelihood Ratio Index reported in table 4 (LR $index_3$) compares the Log Likelihoods' values related to the unrestricted model and to the model forcing the regression coefficients for each of the twelve independent variables to be equal across the six equations. The computed value of this index is much larger than the critical value of the chi-squared statistic with 70 degrees of

[1] McFadden R^2 is calculated as: 1-[log$L$( )/LogL_0] where LogL_0 is the value of log-likelihood function subject to the constraint that all coefficients except the constant are zero, and log$L$( ) is the maximum value of the log-likelihood function without constraints.

[2] According to Sonaka et al. (1989), McFadden R^2, in the range of 0.2-0.4, are typical logit models.

freedom at the 1 percent level. This suggests that the estimated coefficients differ substantially across the equations[1].

Results and possible interpretations regarding complementarities, substitution and independence

The study reports the correlation coefficients of the error terms of the six equations. Most of these correlation coefficients are significant and positive, which supports the hypothesis of interdependence between the different innovative activities. More specifically, the results reveal complementarities between internal R&D, external R&D, and acquisition of equipment and machinery linked to the development and improvement of products and processes. The results also show that external R&D is complementary to the acquisition of other external knowledge linked to the development or improvement of products and processes. Likewise, acquisition of equipment and machinery is complementary to the acquisition of other external knowledge, to training, and to marketing activities related to the development or introduction of new or significantly improved products. Finally, the positive correlation between internal R&D and marketing activities related to the development or introduction of new or significantly improved products suggests that these two innovative activities are complementary. On the other hand, the results show that internal R&D linked to the development or improvement of products and processes is a substitute activity for training activities linked to the development or improvement of products and processes. Furthermore, the results also show that there is independence between internal R&D and acquisition of other external knowledge, external R&D and training, acquisition of other external knowledge and training, acquisition of other external knowledge and marketing activities related to the development or introduction of new or significantly improved products and, finally, between training and marketing activities related to the development or introduction of new or significantly improved products.

In the absence of literature on complementarities, substitution and independence between innovative activities aimed at the development and improvement of products and processes, we are left with an empirical question that can be addressed either at the level of the innovative activities themselves or at the level of the determinants of the innovative activities. The results of this part of our study point to the fact that service firms rely on a large variety of mixes of innovative activities. Why some innovative activities aimed at the development or improvement of products and processes are complementary, while others are substitutes or independent remains a question for discussion and future investigation.

Why do firms undertake different innovative activities? Results and interpretation

Let us now turn our attention to the capacity of the different variables to explain the likelihood that the various innovative activities be undertaken by the firms. The results show that between three and seven variables are significant from 1% to 10% levels in the six equations corresponding to the different innovative activities considered in this study. More precisely, the variety of mechanisms used to protect the intellectual property of KIBS firms is positive and significant in all equations, with the exception of the equation regarding training. The fact that IP mechanisms are not related to training activities aimed at the development or introduction of new or significantly improved products or processes suggests that in the case of KIBS firms, training activities are not related to the acquisition of knowledge that requires protection from imitation by rival firms.

KIBS firms' knowledge development practices have a positive and significant impact on external R&D activities and the acquisition of other external knowledge, which are two complementary activities, but a negative and significant impact on the acquisition of equipment and machinery, and on marketing activities related to the development or introduction of new or significantly improved products, which are also two complementary innovative activities. These results suggest that different innovative activities related to different aspects regarding the acquisition of external knowledge are either positively or negatively influenced by knowledge development practices: they have a positive influence on innovative activities related to the acquisition of knowledge created by other sources (external R&D) or directly provided by other

[1] Hence, for example, a same variable might exert a significant positive impact on some innovative activities, but not on all of them.

external sources, but a negative influence on the acquisition of external knowledge embodied into equipment and machinery acquired from external sources.

As for knowledge management practices, they have a positive and significant impact on the acquisition of equipment and machinery, and on training, but no significant impact on the other innovative activities undertaken by KIBS firms. Again, it suggests that knowledge management practices facilitate the acquisition of knowledge from external sources, whether it is embodied in equipment and machinery or embodied in training activities.

Service firms that have a niche strategy are more likely than other firms to engage in external R&D activities and in training linked to the development and improvement of products and processes. Having a niche strategy exerts no influence on the other innovative activities. It suggests that having a niche provides a focus that facilitates the acquisition of external knowledge embodied in equipment and training activities.

The number of knowledge employees of KIBS firms has a positive and significant impact on internal R&D activities and on the acquisition of equipment and machinery, but no significant impact on the four other innovative activities. It suggests that the knowledge embodied in employees facilitates the creation of knowledge and the absorption of the knowledge embodied in equipment and machinery.

Risk aversion also influences the engagement in innovative activities. Hence, increasing the risk related to the feasibility of innovative projects and the risk related to an innovation's market success increases the likelihood of engagement in internal and external R&D activities, but has no significant impact on the other innovative activities. Not being a subsidiary firm decreases the likelihood of becoming involved in external R&D activities and in training related to the development or improvement of products and processes, but it increases the likelihood of acquisition of equipment and machinery, and the acquisition of other external knowledge. Increasing the size of firms also increases the likelihood of acquisition of equipment and machinery linked to the development or improvement of products and processes, but has not impact on the other innovative activities. Likewise, increasing government support increases the likelihood of KIBS firms to engage in training activities and marketing activities linked to the development or improvement of products and processes. Government support exerts no impact on the other innovative activities. With regard to sector, the results show that the firms operating in the computer system design services are more likely to undertake internal R&D than the firms operating in engineering services and management consulting services. Moreover, the firms operating in engineering and in management consulting services are more likely than firms in computer system design services to engage in external R&D activities. Finally, the firms in management consulting services are more likely than firms in computer system design services to undertake training activities linked to the development or improvement of their products and processes.

V. Preliminary conclusion

The results of this study suggest that various innovative activities are used by firms as sets of complementary innovative activities. These complementarities suggest that some innovative activities that are interdependent and reinforce each other should be considered jointly instead of separately. Conversely, the results show that some innovative activities are independent from each other. Moreover, the results also show that some innovative activities are substitutes for others. These results suggest that firms rely on various mixes of innovative activities in order to develop or improve their products and processes. Finally, the results also show that there are many important differences in the determinants of the different methods of IP protection.

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Managing collaboration for improving design co-ordination

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Abstract: This paper focuses on the co-ordination of engineering design through the collaboration point of view in order to help managers controlling design processes. We focus on the organisation and process aspects to facilitate collaboration between designers working in distributed companies. The IPPOP project fosters the co-ordination of design projects by integrating the product, process and organisation points of view (PPO model) and proposes to manage the collaboration between designers. Indeed, results of the collaborative design activity directly depend on relationships between design actors. For emerging collaboration between different experts, our aim is to allow project managers enhancing and controlling different types of collaborative processes. We propose then a method for storing, analysing then capitalising collaborative processes, in order that they can be formalised and re-used by project managers. This method is based on a tool developed especially for this method, called CoCa. A case study into an SME, designing and manufacturing innovative mechanical products, has been achieved to evaluate the possible feedback to design co-ordination.

Keywords: Design co-ordination, design process management, PLM systems, workflows, collaboration

I. Introduction

Many studies have tried to identify the best practices and strategies developed by enterprises (Balbontin et al. 2000) focusing on environmental challenges, market and customer characteristics, marketing process, product characteristics, new product development process, organizational characteristics and corporate culture, learning practices, and performance. On the one hand (Coates et al. 2000) suggest that task management, scheduling, planning, and resource management are the most important issues when it comes to operational coordination. On the other hand the performance of the collaboration between co-design partners (Martinez et al. 2001), (Giannini et al. 2002) and also with suppliers offers the possibility of gaining fast access to specialist knowledge and capabilities, and of spreading and sharing costs and risks, and of better exploiting the expertise of the partners (Wognum et al. 2002).

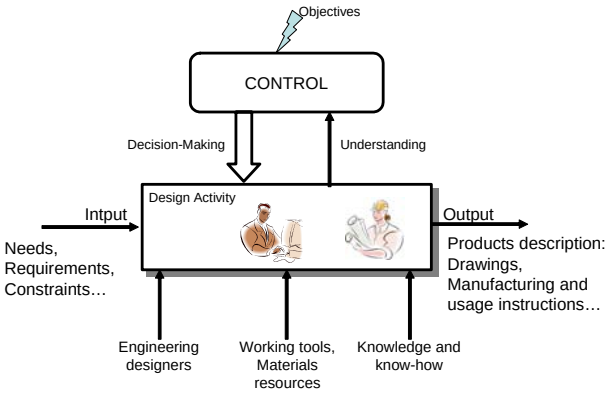

Figure 1: Control of collaborative design model

The coordination and the control of engineering design refer to a global approach to the development of new products. It implies the need to identify the different situations occurring

during the design process and adequate resources to satisfy the initial objectives. Controlling the progress of the design process can be defined as the understanding of existing design situations (in the real world) in order to evaluate them and take decisions that will modify and improve the future process. The control problem here is a problem of decision-making to support designers in their activities in order that they achieve a target in a specific context (figure 1).

II. Design coordination methodology

We introduce in this section the design coordination method developed during the IPPOP project, an RNTL project funded by the French Ministry of Economy, Finances and Industry between December 2001 and June 2005. This project provides an integrated data model related to Product, design Process and Organisation (Roucoules et al. 2006). The main goal of IPPOP project was:

- To propose a generic model to embedded Product-Process-Organisation (PPO) information.

- To identify conceptual links among the three PPO domains. Those links are indeed required to track knowledge (who, what, when and why) related to the whole design process.

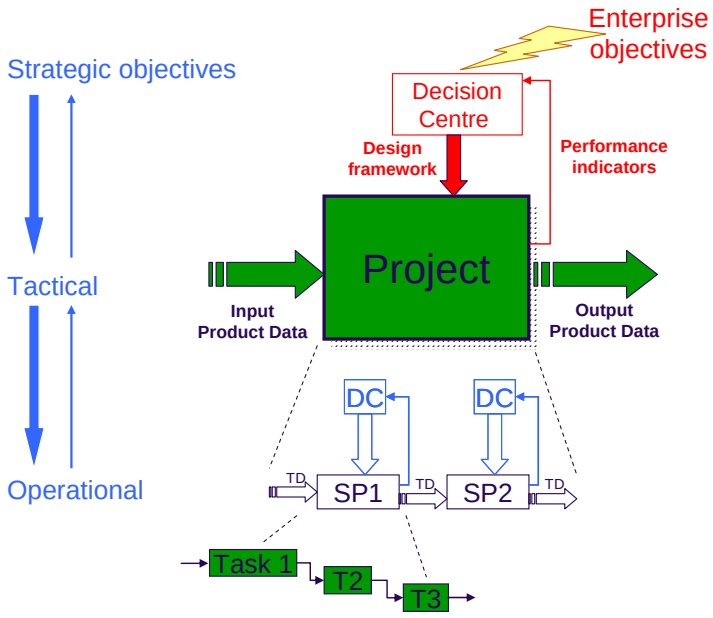

Figure 2. Démarche effective de conduite de la conception.

Figure 2 presents the resulting methodology that allows the use of PPO concepts as well as the coordination and the control of design projects:

- Product concepts (represented as 'Product Data') have been defined: design experts can therefore create several product breakdowns according to multiple levels of detail, multiple experts' points of view, and multiple states of the product (Noel et al. 2004).

- Design Process concepts represent 'tasks' that have to be achieved and relations among them. Those tasks can be defined dynamically in order to go further than an a priori definition of the design process (Nowak et al. 2004).

- Industrial Organisation concepts are based on the modelling of the enterprise design system as presented in (Girard and Doumeingts 2004), (Merlo and Girard 2004) and define a reference breakdown in term of project, sub-project and tasks. Each level is characterised by a specific

context (decision centre, project and design framework) composed of objectives ('design framework'), resources and performance indicators.

The PPO integration is then done via adequate concepts. Product and process modelling are linked via the "product data" considered as I/O of each task and that handle part of the product breakdown. A Project is breakdown into sub-projects and tasks. This naturally links process and organisation dimensions. Performance indicators based on PPO characteristics also give another way of integration by ensuring the return information from sub-levels to upper levels. They are defined using the three dimensions depending on the design objectives to be reached. For example a project manager may control the project schedule progress by defining a time indicator, or he may control the quality of product definition by specifying an indicator based on the maturity of product data.

For decision-making, project managers need to identify effective action levers which will influence collaboration thus increasing design performance. Those elements concern designers themselves, not just the product or the activities.

III. Analysing collaborative practices

In (Merlo et al. 2006) we propose a model inspired by our literature review and industrial case study. It deals with the identification of the main relevant elements for the characterisation of the collaborative situations in design. Collaborative situations could be defined from a co-ordination point of view, with scheduling, planning, formalisation, and the definition of milestones and activities. Alternatively, it could be defined from a human relationship point of view with the persons who are involved in the collaborative event, with their skills, their motivation, and their form of communication. In fact both these two points of view must be taken into account in several collaborative factors to define collaborative events such as: do actors work in the same place or not? in synchronous or asynchronous mode? do they use predefined tasks? and so on.

The model of collaboration is built to characterise collaborative situations which occur during design projects in small companies. This theoretical approach is based on the capture of information describing collaboration between designers. This characterisation is based on the definition of collaborative events of the project. All these events should be associated with contexts in order to understand and analyse the collaboration: both the global context of the project and the local context of a collaborative situation such as date, actor, and expectations of the event, outcomes or taken decision. Moreover, the model should integrate different kind of parameters by capturing quantitative data such as time, activity type or problem solve as well as qualitative data such as quality of communication or interests of actors.

These different categories of information characterise the collaborative events of a design project. This information may be used by the project manager to improve the way he coordinates design processes and actors.

To support this model, we have implemented an analysis tool, CoCa. It does not help with co-ordination (decision taking) but helps to understand design activities and collaborative practices of the company. CoCa allows the capture of events of design projects from the point of view of collaboration and might be used to identify best practices, analyse encountered problems and improve managers' decisions.

IV. Conclusion: from collaboration analyses to co-ordination improvement

An industrial case study has been achieved in a SME which, some years ago, developed a new means of manufacturing structures using honeycomb sub-assemblies. The company has captured several markets with products manufactured using its technology and consequently the number of employees grew from 4 to 40 over 10 years. Our method of experimentation was based on a socio-technical approach (Boujut and Tiger 2002). We have focused our work on

the study of collaboration and relationships between actors and on the design project co-ordination (Pol et al. 2005). This phase is the way to test and validate CoCa tool to help with the analysis of collaboration.

After four months, four different projects have been deeply analysed and more than one hundred collaborative events have been stored. This stored information and resulting analyses show that a lot of information about the collaboration occurring during design projects can be stored. When a problem of collaboration between actors appears in a design event, the project manager is interested in analysing this event in order to understand what was wrong and what could be improved. This will orient the decision to take, improve or reject a collaborative practice that has occurred in projects. Combining different information can lead to detailed analysis of problems or good practices in order to define guidelines to project managers. Such guidelines improve design co-ordination by helping project managers in their decision taking.

Moreover collaboration inputs through the use of the CoCa tool allow the understanding of factors influencing co-ordination and, in particular, to characterise more detailed and flexible design processes that can be implemented by using PDM workflow.

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Innovation Management
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The Karlsruhe Model of Product Development

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Abstract: In general, product development can be understood as problem solving. In the product development process, the problem solving has two dimensions: the life cycle from the profile phase to recycling phase, and the problem solving of the single stages from the situation analysis to the recapitulation and learning. This view defines the two dimension of problem solving in the product life cycle as the macro-logic and micro-logic of the product development. Based on these different approaches, a reference model for the product development was created that displays the different dimensions and supports the different views and approaches. The efficiency of this reference model has been proven in several short time innovation projects. Within four month from the project kick-off to the end, 30 students and two assistant researchers developed innovative products for a company. The focus lies on a strict concentration on customers and their needs, the objective of this project is an innovation not only an invention.

Keywords: innovation management; customer orientation; integrated product development; customer needs; product profiling

I. Introduction

Through the last 40 year of research in innovation and product development processes, each decade was characterised bay a certain Topic. The early product development and innovation research was dominated by the design methodologies. In the nineties the development processes research was more focused on management and economics for example like Cooper and Kleinschidt. Since the nineties the research focus again on certain development processes of systems an technologies, for example micro systems and mechatronics. The question that is not answered until now is still the same. What are the factors that make innovation happen. Schumpeter was the one who claimed that innovation is not only an invention but an invention with market success. How can we find aspect of markets that will make out of an invention an innovation? Can we look into the future and prescribe the behaviour of the customer or user. There are tools shown in this paper that enable us to have a close look on what is possible in the future. There from we can define features that the products must have to be successful in the markets.

II. Research background

Product development processes

Product development and innovation processes are being researched by several different domains. Thus, different domains propagate and develop continuously new approaches. The most active actuators in the field of innovation- and development processes are the management and engineering sciences. Many of these approaches have a special focus on their own domain. This fact can be clearly seen in the case of the design-methodical approaches. They start the development process with the clarification of the development task and the creation of the requirement specification. Many business management approaches, in contrast, end with the requirement definition. Especially Cooper was a decisive influence in the 90s in the change from the design-oriented development processes to business management-oriented product development processes. From these two domains result two dimensions of a development process: design methodology and business management. The task of a development process is to manage the development project and to support the developers

themselves during the development process. The success of a development process depends on the consistency and continuity of the single dimensions and stages. Prasad seizes this suggestion and divides the elements of a development process in different hierarchy levels – organization, product, and process. These dimensions of the product development process are characterized by the stage-oriented protection, the objectives, and the navigation, by the development process itself. This view was founded by Blass, Franke, and Lindemann in the VDI-guideline 2221, in which the stages of the development process are connected to a problem solving process. It is often used as the basis for the design of development processes. Gierhardt divides the model into process level, organization level, and product level, with a target and a knowledge level. In brief, the development process can be divided into systems, methods, and processes, which again link targets, information / knowledge, and activities.

Systems engineering and product development

The basics of the systems engineering-oriented perspective were founded by Patzak and Daenzer/ Huber. Ehrlenspiel transferred the systems engineering approach to product development processes. Describing a product, he refers to it as system of objectives, which is the sum of the objectives (requirements) and their relations. In the system of objectives, the requirements are hierarchically structured according to their importance and the chronology of the sub-requirements. The result is the requirement list and system specification, they are the basis of the evaluation of each developing object system and of the development- or operation process. The market or the consumer that the product is manufactured for has of course also a large influence on the system of objectives Ehrlenspiel defined these approaches, but he did not apply them consistently in practice. In the work of Negele, the systems engineering approach for the description of development processes was revived. Negele developed the ZOPH-model (German: Ziel-, Objekt-, Prozess- und Handlungssystem, target-, object-, process-, and operation system) for the product development. He divided the operation system defined by Ehrlenspiel into process- and operation systems. Steinmaier reduces this approach and combines operation system and process system again to one operation system. In the systems engineering approaches, similar as in the problem solving processes, the system of objectives can be defined as target state and the object system as actual state. With these systems engineering approaches, the product development can be described as the transfer from a system of objectives, being still vague at the beginning of the product development, to a concrete object system. I.e., the core activity of the product development is the continuous expansion and specification of a system of objectives, the creation of an efficient operation system and therefore the successful realization into an object system – the product (Fig. 1).

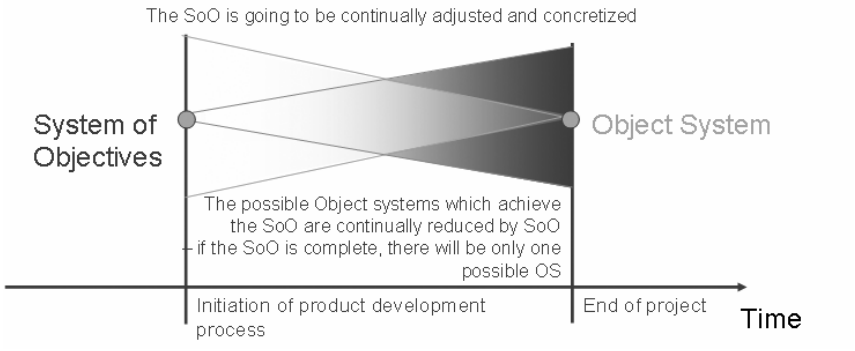

Fig. 1. System of objectives, object system in the product development process

The VDI-guideline describes the process for the development and design of technical systems model in seven steps. The process model of Pahl and Beitz reduces the process to four main stages. Both process models start with the clarification of the development task; this step leads to the requirements, i.e. specifications that accompany the development process. These process models are sub steps of the product creation process and separate the development and design from the remaining product life cycle. In the nineties, it was recognized that the process steps in the development process are not sequential, but highly parallelized and with interlinking. Ehrlenspiel resumes this approach and integrates the personal, informational, and

organizational aspects into the product development process; he establishes the “integrated product development”. The product life cycle is described by means of systems engineering. The influences of all systems on the complete system, e.g. customer, product, production, human resources, methods, etc., are examined holistically.

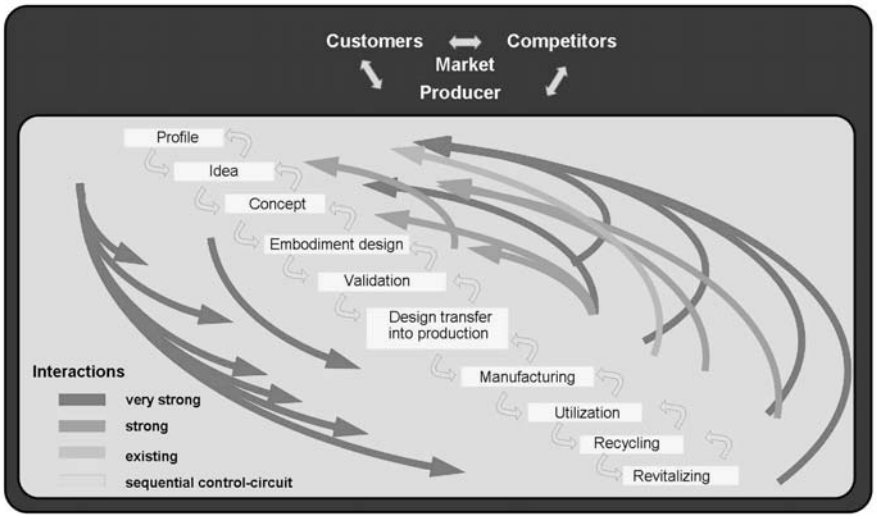

Fig. 2. Stages of the product lifecycle

The process model of Albers (Fig. 2) displays the single stages of the life cycle and emphasizes the overlapping and parallelization of the stages and thereby it describes the interaction of the single stages. The market and its three players (customer, competitor, and the producer himself) is the starting point. Albers incorporates the entire life cycle.

III. The case “Water treatment” and its outcome

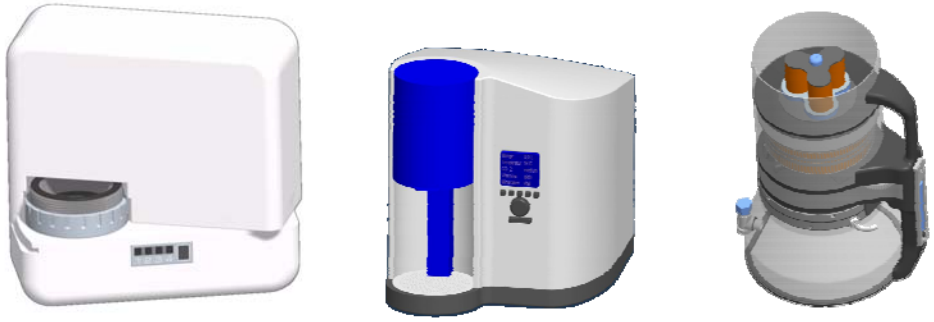

Fig. 3. Innovations created at Karlsruhe (IPEK)

Up to thirty students once a year are chosen through assessment. In the very beginning the students are taught the theoretical background they need to fulfil their task within a one week event lecture outside the university (e.g. process knowledge, creative thinking, team development, project management and project specific knowledge). After this week, we return to the university. The students are divided into five competing development teams of 5 – 6 students per team.

Well, what is the difference to other lectures at universities in Germany? – It is not only a lecture any more. There is an industrial project partner with a real strategically task. The concerning partner was “Freudenberg” with the task:

"Find new products in the field of water treatment"

In fact this was a call for innovation. – The outcome of the project was five different products, four of them are taken out a patent and satisfied partners on all sides. Every concept developed by the students is prosecuted until now.

IV. Conclusion

What is different to what would have happened in the industrial surroundings?

A big point is the students' "open-mindedness" and their motivation, surely. But we think there is another big factor. The students start with an inquiry leading into a scenario workshop. With this workshop, we build up scenarios, which are pictures of possible futures. This can only be done by looking deeply at customers' needs and by putting oneself in the position of the future customer.

In most companies, there are two different departments concerned with this topic. The early phase of product development is done by "marketing department", who give their result to the development department. In our case this all is done by the same people. They gain information and experience with the task, the product specifications and the customers all the time. The decisions they make do not need to be discussed over and over again, because the people who decided and who go on in the development task stay the same and all reasons are in the minds of themselves. Of cause we need different characters in the teams. Of course we need other structures to support their doings. But the success is on our side. There has not been one project until now that had no innovative outcome.

Acknowledgement

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Fostering SMEs networking through Business Ecosystem and ICT

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Abstract: Globalisation is a new challenge for Small and Medium Enterprises; indeed, on the one hand it represents a threat, since new emerging companies are entering their domestic market, but, on the other hand, it represents the opportunity to enter new emerging and growing markets. In order to win this challenge SMEs need to play the networking card; in fact, it is well acknowledged that networking can improve SMEs effectiveness and efficiency which is absolutely necessary to win the globalisation battle. Many public regional institutions are thinking about how to improve the networking capacity of their SMEs through specific programs and investments. This paper reports the results of an ongoing research project aiming at improving the networking capacity of SMEs through an innovative conception of the Business Ecosystem idea. The paper shows how the innovative Networking Business Ecosystem has been conceived and how it works for pursuing this aim.

Keywords: SMEs networking, Business Ecosystems, Enterprise interoperability, Business Research for SMEs, Distributed ICT platforms

I. Introduction

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). This last point is particularly interesting; indeed, an underlying assumption concerning networks is that hybrids are especially good for SMEs. In fact, through networks, SMEs are able to overcome some of the limitations due to their size (achieving scale and scope economies coming from resource pooling) by maintaining the advantages coming from being small (reactiveness, proactiveness and so forth). Recently, several papers have addressed the performance issue for SMEs networks indicating that networks are able to support long term growth for SMEs (Knut and Senneseth 2001, C. Lin and J. Zhang 2005). These results have become so important that public policy in Europe is pushing SMEs in networks with specific programs. This is so true that firm networking is present in several work packages of the 7th Framework Program of the European Commission; specifically the *Activity: 2.2* (Research for SME associations) aims at improving SMEs association (EU Commission 2007a), the objective *NMP - 4.3.3 Networked Production* (EU Commission 2007b) aims at developing research for networked production and the *Objective ICT-2007-1.3: ICT in support of the networked enterprise* (EU Commission 2007c) aims at developing new ICT tools for SMEs networking. This last point is particularly interesting for our purposes. Indeed, networking technologies promise new tools for improving business networking making collaboration and coordination easier. However, ICT can also improve the ability of SMEs to associate in networks. In that case ICT needs to encounter a business paradigm that facilitates SMEs association in networking along complementarities matching and business opportunities discovery; this paper goes toward this important direction. Indeed, it presents a novel methodology for improving SMEs networking not from a co-operation and operative point of view, where different ICT platforms have been already developed, but from the SMEs networks building point of view. For this purpose we have matched a business paradigm, the Business Ecosystem one (Moore 1993) and ICT platform. The result is an evolving technological environment that allows SMEs to create networks by matching complementarities and finding new business opportunities. Since this is an undergoing research project, in section II the main idea of the Networking Business

Ecosystem (NBE) is presented, while in section III an overlook over the Intelligent System underlying the NBE environment is also provided. Conclusions are sketched in section IV.

II. A Business Ecosystem for Business Networking

The aim of the research here presented is to address a new approach for creating SMEs networks through a specific characterisation of the Business Ecosystem concept and the use of distributed ICT platforms. In particular the NBE is the objective of a research project called Sicilian Digital Business Ecosystem (SDBE). The NBE takes inspiration from the European Project Digital Business Ecosystem (www.digital-ecosystem.org) whose main objective is to spread the use of open source software technologies through the SMEs through an ICT platform that allows SME users to adopt open-source software developed by SME providers according to their needs. Such an exchange should improve the development of new software applications, allowing the growth of both SMEs users and providers. The NBE takes inspiration from the idea to share a distributed ICT platform, but it focuses on developing networking opportunities for SMEs registered in the NBE.
In particular, as also depicted in Figure 1, the NBE consists of a set of registered SMEs that interact each other through an Intelligent System Engine (ISE) whose main aim is discovering new business opportunities through a networking integration. SMEs networking opportunities are found by the ISE, that evaluates SMEs aiming at finding sustainable cooperation solutions. The ISE works both replying to a SME specific request, the *Pull Approach*, and scanning the NBE looking for new business opportunities to suggest, the *Push Approach*. In the Pull Approach, a SME informs the system about a deficiency (that can be both a capacity shortage or excess) in its activities; this triggers the ISE, whose *Network Engine* searches the NBE to find out possible partners that can help the SME in solving its deficiency. Possible partners are evaluated and accordingly ranked by the *ISE Network Catalyser*; network potential partners are ranked according to their potential ability in solving SME's deficiency and their attitude that is measured on the base of their behaviour in previous cooperation.

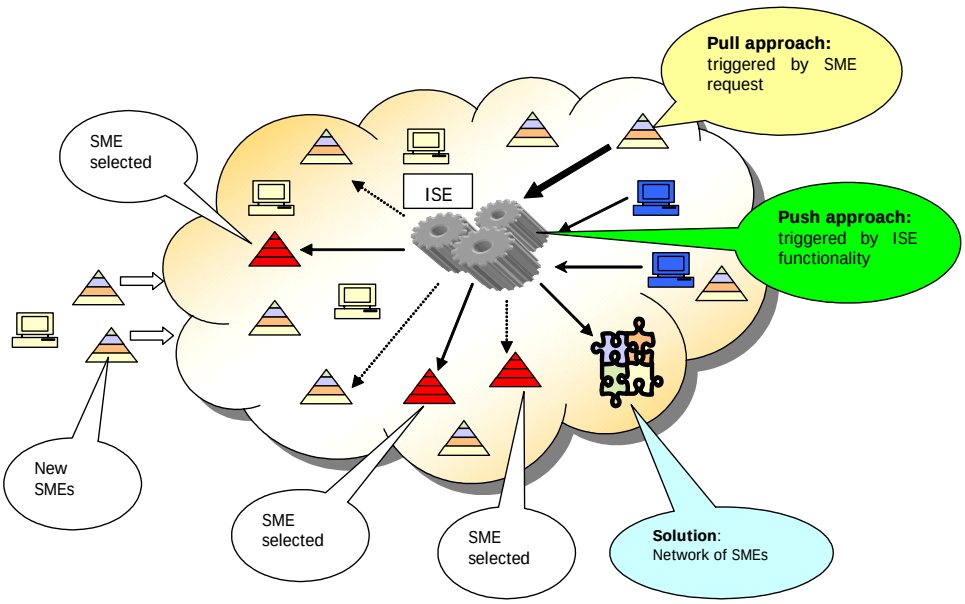

Figure 1. The Networking Business Ecosystem

SMEs whose rank overpasses a threshold level are selected and proposed for a networked solution. The *Push Approach* can work in different ways as deeply explained in Section III. After a relationship is suggested and established, the network is depicted as a separate entity because it has properties that cannot be gleaned from the single component firms information. Features such as the governance system, the network structure, and partners commitment should be evaluated and stated by partners to complete network description. The network is thus evaluated by calculating the performance indicators needed to trigger the evolutionary use of the NBE. Therefore, the NBE consists of several components. A Business Modelling

Language (BML) Editor is used by the SME to describe its business characteristics; it is based on the Semantics of Business Vocabulary and Business Rules (SBVR) approach as proposed by the OMG (OMG 2006). A Knowledge Base (KB) system, that is the set of models and ontologies used to represent SMEs and their requests, is obtained by introducing in the Zachman's framework (www.zifa.com) of Enterprise representation a network-oriented vision of the Porter Value Chain concept. The ISE consists of a Network Engine, that processes the business discovery rules allowing the pull and push modalities. Finally, the Evolutionary System is a set of algorithms that allows the evolution of the NBE knowledge on the base of the networks results. All the NBE is implemented in a distributed peer-to-peer architecture, whose main technical characteristics have been inherited by the EU Project DBE.

III. The Intelligent System Engine (ISE)

The ISE works out according to the three approaches depicted in Figure 2: the Operational, the Strategic and the Evolutionary.

The *Strategic approach* analyses resource and activity attributes provided by the firm with a set of *strategic rules*; by this evaluation, it suggests the best way to manage the activity/resource according to its visibility in customers' point of view, its use as strategic asset, the risk involved in performing the activity and so forth. If the strategic rules set based engine finds out that the best solution is a networked one, the system starts to search partners for possible cooperation. Furthermore, the information provided by the strategic analysis is added to the knowledge base used by Operational approach to find business networking solution. As the reader can notice, the Strategic approach is based on the application of principles of both "Organisational economics" and "behavioural and evolutionary economics" (specifically the Resource-Based View) that sees the firm as a bundle of resources and capabilities able to provide a superior performance. The RBV approach is used to evaluate the firm potentiality and deficiency to locate partner characteristics in terms of complementarities and suitability, a networking S.W.O.T analysis; subsequently, the Organisational economics approach (Transaction Cost Economics, Property Right and Agency Theory) is used to understand the network governance mechanism as a function of the asset/activity to be shared according to the New Institutional Economy approach (Menard 2004). Thus, such a strategic approach allows the firm to focus on its best resources and to rely on resource pooling with external partners for assets that cannot be developed inside or easily traded in the market.

The *Operational approach* is more *operations oriented*. It allows both Pull and Push execution; it works scanning firm's data through a set of Operational Rules aimed at finding bottleneck in exploiting resources. To find bottlenecks, the approach requires to compare average workloads, both in term of backlog and forecasts, with average available capacity. Such a comparison is provided in a value chain perspective since the lack of use of a resource at stage *k* can be due to a bottleneck at stage *k-1*. After a bottleneck activity is located, the ISE suggests actions for both covering the lack or using resources underexploited to establish cooperation relationships. The solution suggested by Business Discovery Rules is notified to all the SMEs selected that can eventually start the cooperation. Once SMEs agree in starting cooperation, a new entity is created in the Ecosystem, thus allowing population evolution.

The *Evolutionary Approach* is primarily based on learning; indeed, its engine is based on updating a set of performance indicators. Such performance indicators are filled by SMEs actually involved in networks suggested by the NBE according to the Operational and the Strategic approaches and by the system itself. SMEs are asked to state their satisfaction for joining the network (i.e. increase in revenue, increase of market penetration, brand improvement, etc…) and to evaluate other partners behaviour, in terms of contribution to network success, reliability, timeliness, flexibility, trust; on the other hand the system provides an objective evaluation of SMEs suitability to cooperation, in terms of completeness of information required, collaboration frequency and use of interoperable IT tools. This set of data allows both population and system intelligence evolution; indeed rules that helped to build

successful networks are proposed to all SMEs experiencing similar situations. Moreover using aggregated indexes taking into account both firms' satisfaction and network success, the engine accordingly updates the parameters used to run the Strategic and Operational Rules set, thus allowing an evolution and improvement of the engine itself.

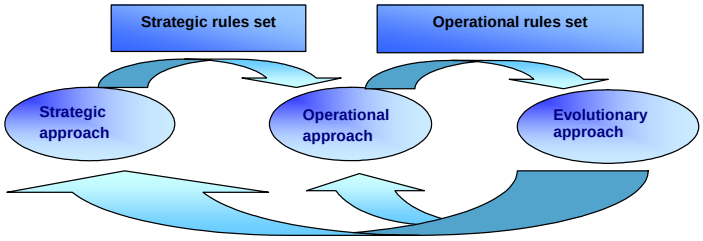

Figure 2. The ISE

IV. Conclusion

This paper presents an undergoing research whose aim is to build an ICT Ecosystem for SMEs Business Networking. As the reader can notice this project is very ambitious and of great relevance in term of scientific interest and public policy. The Business Networking Ecosystem is aimed at discovering new networking opportunities for participating SMEs by matching both a Strategic, Operational and Evolutionary point of view. The research core of the project is the ISE, whose set of rules is called to locate and discover new networking solutions. In order to do that at strategic level, the ISE encompasses and formalises the most relevant literature on Theory of the Firm and Firms Networking; at Operational point of view it uses a formalisation of the Porter Value Chain approach, while at Evolutionary level it uses learning and knowledge evolution. While this paper provides only the general description of the Networking Business Ecosystem, forthcoming papers will describe in further details its valuable components.

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Innovation in practice: The case of a medium-size multinational manufacturing holding

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Abstract: This paper aims to present the experience of Arteche, an industrial group focused on electrical equipment design and manufacturing which is based in Spain and has nine production plants distributed worldwide. In 2000 a strategic decision was taken to diversify the business of the company and establish a corporate innovation management system. Today Arteche's income has increased by 70% and the weight of the new activities amounts to 20% of the total.

After a brief introduction to describe the business context, we explain the steps followed from the definition of a technology plan –a true roadmap for the entire period– to the implementation of a process to mature ideas into new product lines, as well as the overall reorganisation of the group to account for the new business reality. We also state lessons learned along this ongoing path in which both failure and success had a role to play.

Keywords: Innovation practises; innovation management; R&D organisation; electrical equipment manufacturing

I. Introduction

Arteche was founded in 1946 as a small plant producing electrical equipment for the Spanish market under international manufacturing licenses. By 1972 Arteche's portfolio included instrument transformers and auxiliary relays, and the technical capabilities acquired by then allowed the company to take one step further and design their own products. It was soon realised that a sustainable growth of the business required a market view broader than the one allowed by the national scope of their original activities, so in 1975 Arteche went international. In successive years the company accessed increasingly exclusive international market niches associated to higher voltage levels and product complexity and, correspondingly, to more stringent quality and reliability requirements for their products.

Today Arteche is an industrial holding focused on the design, manufacturing and sales of electrical equipment for power system metering, protection and control. The company's headquarters are in Mungia, close to Bilbao, Spain, and the total number of employees is around 1,800. The portfolio of products and services includes instrument transformers for indoor and outdoor service in the entire voltage range up to 765 kV, auxiliary relays, protection digital relays, integrated substation protection and control systems, capacitor banks, filters, substation and industry meters, communication equipment for power line carrier and broadband over power lines, switchgear, and other transmission and overhead distribution equipment, as well as turn key solutions in the electrical sector, mainly substation projects, power quality and distribution automation. The holding comprises nine manufacturing plants in Europe, America and Asia, with sales offices and agents in more than sixty countries serving customers world-wide. The company is still family-owned, which provides a much valued independence.

In the following pages we explain the main actions taken and the results achieved since the strategic decision was taken to push technological innovation and seek new business opportunities. The next section introduces Arteche's business context and discusses various approaches to innovation. Section III summarises the initiatives implemented and the subsequent changes in the organisation. In section IV some aspects are highlighted which were found to be decisive along this journey –a real process of change and learning. We end up by briefly extracting some conclusions from this experience.

II. Innovating to compete in the electrical sector

Arteche has always operated in the electrical sector, a traditionally cautious and stable business field which lately, however, has shown signs of dynamism. The same as in other sectors, the electricity business is facing a period of global change during which new policies and regulations will be called upon, updated infrastructures will be required and innovative technologies will have to be embraced to fulfil the expectations of liberalised markets and the renewed values in society. We will be witness to important changes in electricity supply, as demand rises and traditional resources are depleted. The long-established grid with large centralised generation and power flowing in one direction through transmission and distribution lines will evolve into more flexible, controllable, environment friendly and user-centred structures. The concrete situation and rate of change is different in each country, but some general trends can be perceived in this shift towards the power grid of the 21st century:

- Increasing digitalisation, sensorisation and automation
- Integration of electricity and communications
- Integration of distributed power sources, with distribution grids accommodating bi-directional power flows; deployment of reliable microgrids to satisfy local needs
- Substantial improvement of power quality and efficiency
- Control extension over generation and power supply
- Multiple choices for end users, including active demand management
- Predictive maintenance based on equipment condition
- Demand of complete solutions, enabling important market opportunities to concentrate in the hands of big multinational corporations

Within this evolving context Arteche competes in different market fronts. On the one hand, competition is global for the higher voltage levels, for which product quality and reliability are crucial and technological excellence is a must for gaining the confidence of customers. This is the perfect market context for international corporations with a comprehensive solutions offer and complete product packages. On the other hand, for technically less demanding products and in lesser margin markets in which short delivery times are decisive, pressure comes from an increasing number of local smaller size competitors.

It was in this scenario that in 2000 the Board of Trustees and the Management of the company agreed on an explicit growth and differentiation oriented strategy. In addition to the classical actions targeting an increase of competitiveness either through cost reduction or by improving existing products, they perceived the importance to promote innovation as a strategic attitude that would bring business value by launching new product lines, exploring new markets and adopting new ways of doing.

If an organisation aspires to a sustained competitive position, then it will have to put in practice all three types of innovation mentioned above. Cost cutting implies an efficiency improvement or some process reengineering, ultimately through actions that either limit the volume of resources required or allow for a productivity increase with the capacity available (Davenport, 1993). There is a whole body of experience, references and best practices on this traditional approach that, unfortunately, will be of little use in developed societies where companies rest upon heavier cost structures than competitors from other regions.

Improving current products and services can be achieved by adding new functionalities, improving quality or reducing service times, for example. The same that happens with initiatives aiming at cost reduction and increased efficiency, the goal here is still to compete better in order to keep or to increase one's share in current markets, and changes are basically orientated towards transforming internal aspects in the organisation (Vyas, 2005).

Such process and product improvements can be seen as two types of innovation in the wider sense of the term (they are sometimes referred to as gradual or incremental innovation). There is a qualitative difference, though, with the type of innovation usually described as radical or strategic. In this, more restricted case, the company strategy is reinvented in order to develop

and transform the market, and seeking a leading position in well identified niches. The effort to differentiate oneself from competitors requires, moreover, that an original path is pursued: success recipes from third parties will be of no use here. The obvious risk, then, is that investments -both in material and intangible fixed assets- are required to renew the technological and organisational capital of the company, and the return on such investments is not assured *a priori*. The classical, dual view of disruptive and sustaining innovation described *e.g*. in Christensen (1997) and Christensen and Raynor (2003) was further refined by McGahan (2004) in a finer grain classification of industry change trajectories.

III. Actions taken and first results

The vision of Arteche as of 2000 included an unequivocal statement on the "high-priority and radical need to bet by technological innovation and new products research." Next we describe the main steps taken since then and also provide a few data that show the evolution of the company and the impact of the actions derived from that decision.

1. Technology strategy

The definition of the technology strategy was led by the then newly set up Innovation and Technology Management. The creation of this corporate unit in 2001 was the first organisation related action after the decision to foster innovation. The next step, then, was to analyse the market evolution and technology trends in the electrical sector. This was a strategic reflection guided by the corporate goals of growth and diversification, an exercise that included the writing of a planning document covering the following aspects:

- Vision of the intended mid-term technology specialisation, mentioning the development areas most suitable for innovation activities
- Identification of an initial set of target products in each one of the selected technology areas
- Decision on the preferred way of acquisition for every technology and product identified
- Allocation of resources to implement the strategy

Building on top of the practical and economical foundation underlying business decisions, the technology strategy must contribute to develop the future of the organisation (Matthews, 1992). The vision should be relatively ambitious and motivating, and so the strategy may be considered as a set of challenges to be solved together with the means available for that. The technology plan amounts to an estimated *map* that will guide the transition from the starting situation of the company to the technology goal put forward.

2. Innovation system

Based on the previous reflection the innovation system was defined, *i.e.* the set of policies, processes and practices that make up the framework intended by the company to contribute knowledge and to solve the challenges posed in the strategy. The following are the main activities conducted in that sense:

- Agreement on the innovation scope of the various units in the Group comprising technological capabilities. It was decided that business units would be in charge of short to mid-term improvements as well as product development involving mature technologies, whereas the corporate unit would lead strategic innovation and longer term product development projects dealing with new technologies and business opportunities.
- Definition of a methodology -sometimes known as innovation process- to systematically evolve and filter out new product ideas from the moment they are conceived to their commercial launch as new product lines (Cooper, 2005). A filtering committee was established to administrate this stage-gate process according to previously defined criteria.
- Internal training on the new technologies prioritised, typically as part of new product developments with external expert support. The technical teams involved in such projects are often multidisciplinary and geographically distributed. The original product ideas evolved and matured as they proceeded along the steps of the innovation process,

resulting in new business lines to be operated, for the moment, in European, North and South American markets.

- Technical advice on company acquisitions in line with the technology objectives set forth.
- Collaboration agreements and liaison with external agents (companies, technology centres and universities) in technology transfer and product development projects.

3. Some data (2006)

- Number of production plants: 6 focused on the traditional business and 3 in new activities (*vs.* 5 for traditional business in 2001)
- Product families: 51 (they were 32 in 2001)
- Share of new products in global sales figure: 21% (0% in 2001)
- Increase in sales volume since end of 2001: 71%
- Increase in staff since end of 2001: 36%

IV. Key aspects when implementing an innovation system

According to our experience there are matters that happen to be vital for the successful implementation of an innovation system. The relevance and complexity of each aspect may differ from company to company depending on their business environment and culture. We have found, however, that overall they constitute a set of interrelated and necessary measures without which systematic and sustained innovation will not be feasible. A good many implementations have been reported to have failed, precisely, for neglecting one or more points from the following seemingly trivial list:

- Commitment culture to accept challenges, risks and failures in a true and coherent manner. Last year Arteche was reorganised in business units, some of which were established in the wake of the technology strategy and incorporate acquisitions in Brazil and Mexico. Nowadays the company is a two-facet organisation in which units focused on traditional businesses and exploiting well-mastered technologies in stable markets coexist with new divisions relying on technologies, markets and business models that are new to the Group.
- Leadership at the highest level. If support only exists at this level, then systematic innovation will be difficult to achieve; but if it does not exist at this level, then innovation efforts will be in vain. As explained above, a corporate Management was established at Arteche lo lead this movement. The Innovation and Technology Manager is a member of the Group Management Team and reports directly to the CEO, whose support is determined. A so-called Diversification Committee with members from the Board of Trustees, Management and external experts is also in place to follow through strategic aspects of innovation and secure their alignment with the overall company strategy.
- Flexibility when applying internal rules and standards related to the innovation system. Having a method is fine, but common sense should prevail to allow for justified waivers and exceptions. The technology strategy itself must be fed back with input from the implementation experience, and it is to be kept alive with adjustments whenever required. Pragmatism and the unexpected evolution of business environments will drive changes of course that may also be advisable in the face of unforeseen opportunities. There exists nothing like a universal way to innovate.
- Attitude that favours exploration and anticipation, seeking actively in the surroundings to identify and process signals of change, opportunities and threats. Quite often, again, this attitude requires flexibility to allow going into action quickly. One of the current product lines of Arteche, for example, was not anticipated when the initial strategy was drawn up. At one point, however, we had the choice to exploit our experience on the medium voltage network in a novel communications application. The filtering committee decided to support the idea even if some of the requirements defined in the innovation process could not be fulfilled for that nascent, still to be configured market. When taking this decision, the promising bid with limited risk took priority over the thorough fulfilment of the steps envisaged in the method.

- Importance of learning and of holding on to a medium term perspective, rather than assessing the outcome of new initiatives only from short term results. At their onset, for instance, newer business units might show a weaker financial profile than more mature ones. A short-sighted analysis devoid of any strategic justification could put in question some of the decisions taken. A longer assessment horizon should be assumed, however: current decisions prepare the company for the future.
- Culture of training and collaboration, both within the organisation (exploring new combinations of knowledge and skills) and outside of it (to gain experience and acquire new technologies). This being a basic premise to innovate, it often requires leaving aside previous habits and prejudices. In the case of Arteche, innovative product development projects typically require the participation of up to four internal teams from different countries, plus one or two key external technology suppliers. In the relationship with the latters we should not lose sight of the training objective so that technology transfer is promoted rather than, say, a mere subcontracting of designs.
- Dialogue and debate. To innovate means to change. Resistance to change is unavoidable, so keeping fluid internal communication channels is mandatory and the implication of all parts must be pursued right from the beginning. Tradition and local culture have a great influence in organisations as well, and we had better be realistic about related curbs and difficulties when planning projects and estimating efforts.
- Due care right through the launch and first steps of new business lines. The objective might seem fulfilled when an idea matures up to the point when it officially flies off. Nonetheless, there is still a risk that the initiative fails if the person in charge has not been adequately selected, if she does not have the internal support needed, if no clear goals have been defined or if the new business lacks access to the minimum infrastructure required to market their products, to name but a few reasons. We found that it could also be counterproductive to try to fit all new activities into traditional business management schemes.
- Excitement, motivation and acknowledgement. Innovation cannot be brought forward by decree, and so organisations are dependent on people, the true innovation driver. Promoters of new ideas will have to overcome internal restraints and external difficulties, and their discouragement is to be avoided. Creative people tend to develop their full potential in working environments that are open from the communication standpoint, with little hierarchy and a flexible organisation where they enjoy some autonomy and their contributions are acknowledged. The extent to which that might be put in practice will depend on the circumstances of each company but, in any case, this is a point whose relevance cannot be overemphasised.

Interestingly, none of the topics mentioned above is of a technical nature. They all touch upon people-related, *soft* aspects and they coincide, to a great extent, with subjects that are also highlighted *e.g.* in total quality and modern business management treatises. In essence, they also agree with observations by authors like Tucker (2002) and Cooper, Edgett and Kleinschmidt (2003).

V. Conclusions

Arteche is a medium-sized manufacturing holding with international production facilities and sales in 125 countries. In this paper we have described their business context, actions taken and lessons learned during the implementation of an innovation system. This process is not completed yet, but the experience so far has been worthwhile. The decision taken to foster innovation as a driver for growth and diversification has resulted in a renewed organisation where traditional business units strive to increase productivity and more recent business units are developing a portfolio of new products, many of which are based on novel technologies. All of them are also extending their activities to new markets.

Today the company is the result of a decided commitment to innovation, understood as a transition from the traditional values of production and quality toward a new business culture according to which the goal is not is not only to do more of the same or to do it better, but also

to do different things and do them before others. Despite difficulties along the way, all in all we believe that the bigger risk would have been not to take any risk.

Market forces are varied and complex, and so it will not be possible to single out with certainty one sole reason for success. We feel, however, that the innovation journey started five years ago has had much to do with the current competitive position of our company, and we are certainly ready to keep the same level of commitment in the years to come.

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A general framework for co-working projects

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Abstract: Procuring a sustainable advantage over the competitors is a goal of all firms and therefore they should be both operationally and strategically efficient. However, as firms work with other companies for almost all of their projects, they are under threats of misunderstanding, inefficiency, difficult synchronisation, etc., real traps for target achievement. In this paper authors propose a global framework that focuses on collaboration for co-working projects related to the collaborative product development projects aiming at minimizing these harmful potential consequences. This framework emphasizes critical characteristics of any collaboration among partners and allows a clearer understanding of the overall environment of such projects. This understanding leads not only managers towards a better definition of the strategy but also guides them to acquire a more resourceful operational efficiency.

Keywords: Co-working project, product development framework, business efficiency

I. Introduction

According to M.Porter [1], firms have two ways to achieve a sustainable advantage in their business: strategic positioning and operational effectiveness. He resumes strategic positioning by "Do different things than competitors" and operational effectiveness by "Do the same things better than competitors". This latter objective was that one of Japanese companies for many years Porter says and it allows their huge growth for several decades. However, the sustainable advantage cannot come only from operational effectiveness because the competitors will reach the same level of efficiency more or less rapidly. He argues then that the companies should think of their strategic positioning, by doing different things than their competitors to remain at the top the market economy.

The academics and practitioners understood this idea and look for methods which may support their march towards this ultimate goal. Especially for those who were focused on product design, approaches such as Concurrent Engineering CE, Integrated Product Development IPD or Dynamic Product Development DPD were set up. Since then, these various methods and approaches evolved and were improved. But, several parameters such as the intensification of exchanges between various countries, the use of electronic exchanges and finally the Internet make easier the use of these latter methods for every company. This means that new paradigms are necessary to answer again the strategic positioning need. In this paper, we define a paradigm for co-working projects which is argued to allow a firm not only finding a sustainable position within the market but also an operational effectiveness of its business, closely linked with its partners. After a short state-of-the-art in section two, we will define this paradigm by providing its major concepts. Some conclusions and specifically some challenging perspectives will end the paper.

II. Previous works

To study co-working, we consider interactions between product design (and its management) and network design (and its management). Vonderembsea in [2] resumes the design of supply chain as an issue of product design. Based on our research the idea of simultaneous design of product, process and supply chain, was proposed first by Charles H. Fine in his book [3]. He

proposed the concept of clockspeed which covers the evolution rate of industries. Fine shows that the conjunction between these design activities forms a fundamental element which can ensure the business success. He called the global framework three-dimensional concurrent engineering *3D-CE* and proposes a method, *Double Helix*, to define the firm' strategy based on its relationships with suppliers, customers and its market position. Fisher in [4] distinguishes two categories of product: primarily functional or innovative. He shows that the supply chain depends directly to the category of the products. He distinguishes physical cost (transformation of raw materials) and market mediation cost (ensure that the products manufactured by supply chain correspond to the needs of customers). He proposes also tools necessary for a manager to define whether the firm's products belong to functional or innovative. Fixson works within the framework of 3D-CE and defines a method to design the product family architecture. He studies the product architecture especially the coupling between components and their interfaces but did not consider the influence of the product architecture on the way that partners of the product development should be selected; neither the way that the potential partners' specificities influence the product designers' job. These pioneering results showed that the joint design of product, process and external organization could represent an efficiency potentiality. In what follows, we will enlarge the framework defined before into what is called "co-working project".

III. A model of co-working project

By focusing on co-working project, this self-understandable concept, we would underline the fact that the problematic considered here should be regarded to for any product development project. We study co-working projects as global business projects from the point of view of a given company wanting to put on the market "new" products. In this context, by "new" we mean *design or re-design of a subset of functions and/or components*. So, the associated innovation may concern product, process or management and organisation and obviously they could be incremental or radical. The co-working project is then analysed from the generation of an idea till its industrialisation and sale.

3.1 Co-working phases

We suggest subdividing every co-working project into three main phases: Analysis, Design and Do (*cf*. Figure.1). These phases have complex overlaps (*cf*. past results of authors) that cannot be discussed in this extended abstract. Readers should remark also various arrows. They mean that there are complex *feedback* and *feedforward* relationships between phases from one side and between the control/supervision systems and their controlled systems from the other.

During the analysis phase, the goal is to ensure the business objectives by putting the products on the market, as soon as possible and under the most interesting conditions. Managers answer several questions and especially an important one: go - no go? This answer guides future actions of the company. But the complete answer calls for an analysis which considers the constraints of partners too. Managers have to know if a potential supplier *S* will be able or not to produce 100 units of the component *C* per week, for instance. If no, designers may change the product architecture or may choose another supplier! Therefore, the question of partners should be posed from the very early steps of the collaboration. This is the reason why the analysis phase is divided into two steps: *internal* analysis and *trade-off* analysis. Once the internal analysis of the focal company is done managers should perform a trade-off analysis with the *inescapable* partners of the project. A partner is inescapable if the project cannot begin without its participation. This is the case, for example, of the motor vehicle equipment manufacturers (Delphi, Valeo or Bosch) for car makers (Renault and Volvo for instance). The Design phase corresponds to four design processes which run in parallel: *S*ervice design, *P*roduct design, *I*nternal facilities and organisation design, *N*etwork of partners design. The way that these processes are presented in this figure underlines that they are coupled closely together and any modification of one may have consequences on the others. We call this the SPIN model. These processes (re-)design all the elements necessary to perform as properly as possible any co-working project.

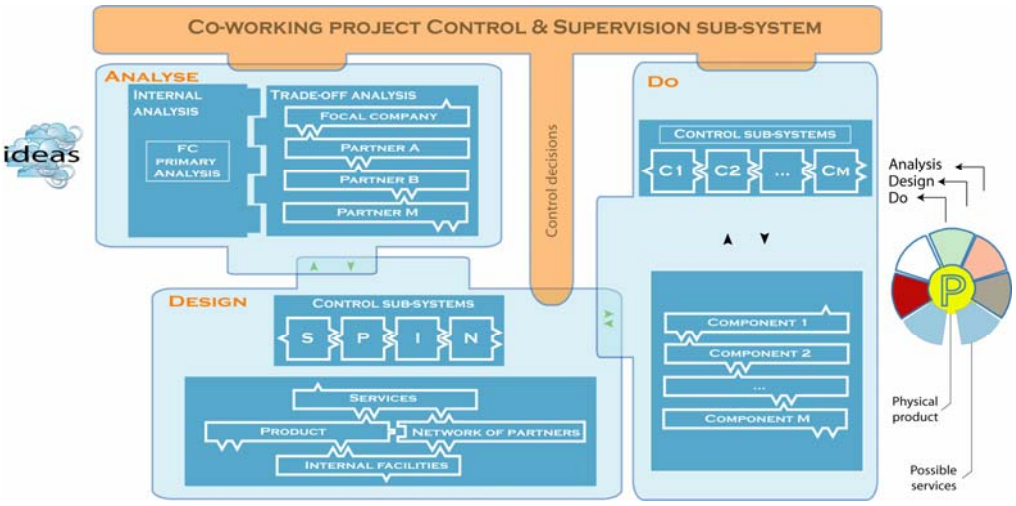

Figure.1: The framework of co-working projects

Finally, when all the outputs of these design processes are ready (designed or re-designed), the production of the product and its associated services can begin. This corresponds to the Do phase of the co-working project. The whole co-design project can be viewed as a controlled system conducted by a specific control and supervision sub-system. Each of these processes is controlled by a specific control sub-system. The control and supervision sub-system of the design phase nevertheless can be split up into four distinguished modules, each one specialised for one of the four SPIN processes. Obviously, these modules work dependently.

3.2 Constraints

To complete the co-working project framework, constraints are added to it. These constraints translate the way that one process or phase interferes with others. We subdivide globally the constraints into two classes: *inter-processes* constraints and *inter-phases* constraints. The inter-processes constraints represent all existing constraints between the processes of a given phase. Concurrent engineering for instance is a field that studies the links between the design of product and internal facilities/processes while 3D-CE looks for connections between product, internal facilities/processes and network. The inter-phases constraints model links between processes of two phases. Design-for-Assembly or Design-for-Manufacturing represents the fields which study a part of these inter-phases constraints.

3.3 Three types of co-working project

The interferences between a company and its partners may begin at any phase of a co-working project. This classifies the projects into three classes: co-production, co-design and co-analysis, scaling from the least to the most collaborative one. Every type of co-working project has its own specificities and imposes specific constraints to partners but intuitively we can say that the co-production projects correspond to the most common relationships between the company and its suppliers or sub-contractors while for a co-analysis project, partners participate to the project from the beginning. The co-design project is launched when the analysis is already done and managers should determine the most relevant set of partners for their goals.

3.4 How this framework should be used?

The global co-working project framework shown in Figure.1 captures those aspects that must be taken into account from the beginning of the project:

1. While analysing the project, managers have to think of not only the design phase but also the do phase. This is “Analyse-for-Designing” and “Analyse-for-Doing”.

2. While designing the product, designers have to consider not only the design inter-processes constraints but also they should think of the do phase from manufacturing or assembly point of view and also from the management point of view. Somehow, it might be phrased as “Design-for-Management”.

By considering these connected problems, any company manager might think of opportunities and threats a co-working project may generate. To understand better these aspects, we have modelled their interactions using GRAI-net formalism. These phases, somehow drastically simplified, can be represented by activities model: the analysis and design phases can be modelled by a *decision* activity (defined by: objectives, resources, decision variables, decision criteria and constraints and additional information, represented by a vertical semi-arrow) and the do phase by an execution activity (represented by horizontal semi-arrow), see. Figure.2. This aspect is explained in the complete paper.

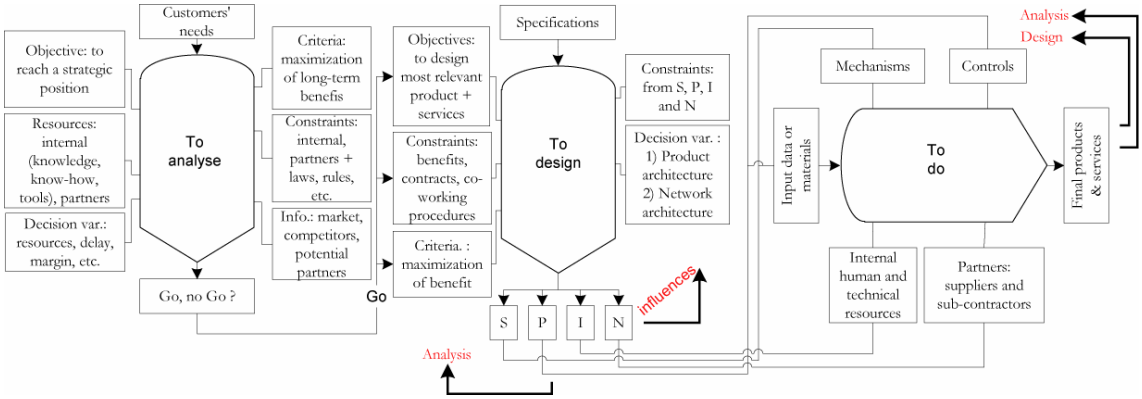

Figure.2: Mutual influences between various phases

IV. Conclusions

By taking account of various constraints, identified through and within the global co-working project framework, the company could prepare an action plan for collaborations which allows managers to, a) prepare the necessary logistic infrastructure for product and data exchanges, b) negotiate with partners using estimated parameters of co-working procedures, c) construct win-win partnerships with partners which develop partners' loyalty, d) organize the network of partners for effective networking and e) eradicate useless tasks as much as possible, especially during the product design process which induce future time and money consumption. These activities, direct consequences of the framework consideration participate not only to the strategic position of the firm but also to the efficiency of actions.

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Towards a dialogic management of cognitive competences.

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Abstract: In this paper we examine the nature of the competences needed for promoting innovation and change. We began from our experiences as the starting point, examined the literature and interviewed managers and those responsible for innovation and discovered that our research contradicts the simplistic view of innovation facilitation and management material in the work place. Our research suggests that for innovation to take place two contradictory notions, the order principle and the disorder principle; have to be engaged at the same time. A positivistic epistemology is unable to handle contradictions. Therefore we suggest the use of Morin's "dialogy" as a way of managing this contradiction.

Keywords: Innovation and change, order and disorder, management, contradictions, dialogy

I. Introduction: skills and competences for innovation and change

Starting from the base of our experiences of innovation, we have evaluated case study literature, interviewed and observed managers and those responsible for innovation we have gathered contradictory information. As far as competences for innovation and change are concerned, people would prefer to do one thing but believe its opposite. Autonomy and initiative, motivation and involvement and the capacity for understanding issues under their dynamic and positive aspects are often quoted in the literature and by practitioners as the basic conditions for innovation and change. But at the same time, the same persons would like to have more discipline and submissiveness in order to proceed in an organized manner and synergistically to meet the strategic priorities of the group, the department or the company.

Positivist epistemology does not easily accommodate such contradictions into account and to make them central to our understanding of innovation or positively changing environments. The analysis of the interviews we have performed reveals that managers who have to achieve innovation, have difficulties in understanding, acting to generate 'breakthrough' thinking and undertaking radical change (the disorder principle) whilst at the same time, gathering and channelling energies (the order principle) which is the result of an efficient and tight group. In order to address such a fundamental epistemological conflict, we introduce the concept of "dialogy", taken from the epistemology of complexity by Morin (1995) as the basis for our explanations and proposals.

II. Complexity and the concept of "dialogy"

The concept of a "dialogy" by Morin (1995) proposes accommodation of "the included third" in one's cognitive processes. This concept is the opposite of the concept of "the excluded third" omnipresent in occidental thinking from Aristotle's philosophy to the modern philosophy. Morin proposes "the included third" in order to generate "thinking different" by the use of an epistemology for complexity. If we admit we are dealing with complex issues, which is obviously the case when managing innovation, we have to invent complex epistemological tools and to find a way for people (those responsible and eventually all in the company). This is concept of "dialogy".

The argument for such a posture is that when we define contraries and contradictions in our current ways of conceptualizing, it is probably not because such things are opposite by nature, but because they appear opposed as a result of our conceptualizing cognitive processes. That is why we have to change the way we conceptualise such contradictions. Our thinking processes are heavily conditioned by positivist assumptions (no contradictions, single truth, objectivity…) and by our language (Foucault, 1962) we give "labels" to things with hidden assumptions that words correspond to things and describe things, each word or expression defining a boundary and an "substance" encapsulated within the boundary. The consequence of such a posture is that a thing must be inside or outside the boundary. This last rule is known in the Aristotle's epistemology as the "rule of the excluded third". We have to think differently, introducing, as a complement to the binary the dichotomy approach which is the focus of the paper.

Morin's work is obviously strongly linked to constructivist epistemologies, basically assuming that knowledge must be considered as the fruit of one's mental constructs (representations) and not as "photographs" of any existing ontology (more evidently if we deal with immaterial and tacit or implicit referents). This reflection suggests that we must critically challenge (deconstruct, if we use Deleuze's vocabulary) the mental representations, ideas and cognitive processes we are producing, at least as far as we are able of a self-conscience of them1. One of the conceptual tools for doing so is "dialogy". As far as cognitive competences2 are concerned, it is important to admit that we need competences of one type and also of the opposite type. We have not only to admit contraries, but also, if we think that cognition is essentially made by separation (creating categories using the "rule of the excluded third"), then we must also consider that such boundaries are arbitrary and cognitively determined. Therefore, we need to imagine (to build cognitively) what may happen in the trans-boundary space (between categories and between opposites): how opposites build and condition each other?

An important consequence of this epistemological refection is that the structuring categories that we propose for a given issue (behavioural competencies for instance) must be understood as a proposal for more intelligibility for the issue, not an ontological one. This is more akin to Checkland's (1999) use of the concept of a 'notional system' i.e. such systems exist only as a notion for bringing about changes in thinking. Consequences of such an approach to management is that a posture offers a more complete and dynamic appreciation of a complex issue but not necessarily a ready solution in terms of organization (structure) and actions to be undertaken. However, it is important to note that it is a cognitive construct (representations) which is neither impartial nor objective, but a mere "product" based on our opinions and beliefs, our intentions and our ways of working and thinking during the process.

As far as "answers" are concerned, the issue of what kind of "question" to ask is obviously a central one. If one considers the question of cognitive competencies from the point of view of which one must be improved, developed and acquired (learnt) for innovation and change (the case in this reflection), one will build an "answer" to this question, not to another one! Obviously, the answer will be made up from a list of competencies (abilities to…) including competencies that would be considered as being opposite to traditional epistemology and trying to understand how these opposites may influence each other. Therefore, the question of these competencies' holders is not addressed: must the same person possess one competence and its opposite and be the "motor" of their interactions? Must opposed competences be held by different persons? Is the answer to this question contextual? In fact, the question of what kind of management, organization, methods and tools must also be examined as an equally complex issue (we are definitely out of the "one best way" tale), assuming the same epistemological assumptions and using the same cognitive processes.

III. A dialogic glance on cognitive competencies

The study we have performed on the conditions favourable to innovation and change in a "small social corps" (a small company, a department, a group, a project team, etc) shows that the

[1] This reflection opens the door to the development of one type of competences which is rarely considered: the cognitive competences, and particularly one of them, related to learning, reflexivity and self-conscience. This paper will focus on them.
[2] We will define the concept of "cognitive competence" further.

improvement of behavioural competences constitutes a key ingredient. Such competences are today very fuzzily defined (Calvez and Nekka, 2006). Innovation cannot offer its full potential, or even be impossible to achieve without the acceptance of positive attitudes of people. It is the focus of this paper to deepen such a key issue, discussing particularly a specific kind of behavioural competences: cognitive competences. This approach will be made using the dialogic mode as its epistemological base.

What are "cognitive competencies"?

In today's environments, we notice that behavioural competencies are of key importance. The point we try to highlight here is that behind behavioural competencies there is another kind of competences that we name as "cognitive competences". We think that new global and dynamic environments change the groundwork on which change is being considered. Challenges paused by change, are becoming much deeper and harder in the western countries. We are not really aware of what is happening, as classical cognitive assumptions and solutions do not seem to apply anymore. Therefore, as simple workers or managers, we neither know how to behave, nor what may be the relevant solutions. Complexity is often the word which expresses these difficulties.

However, as far as complexity is concerned, a particular observation is that in innovation and change issues, good practices, successes and positive results often seem to be considered as if they are exceptions or like unusual facts, or as if the normal state is negatively charged. The challenge, as far as change and innovation are considered, is to make these desirable aspects to be considered normal or positively charged. Obviously, "negative charge" feeling is also a cognitive matter. Following the theory of conventions (Reynaud, 1989), if people have a negative opinion of their work environment then their relationships and conceptualizations are negatively charged. Because they are negatively charged (failures, routines, lack of interest, etc.) people carry on developing negative mental representations. It is what Hämäläinen and Saarinen (2006) call a "system of mutual holding back" in which the fact of considering issues negatively produces negative thoughts. This means that mental representations and local actions led in active relations to each other must be one of the entry points to the issue.

All these competences related to the way of conceptualizing problems and understanding world and its dynamics must be developed and learnt by actors. However, as suggested in the theory of action learning through "cognitive redefinition", (Schein, 2002) or applications of "enaction" theory by Varela and Maturana (1980), we believe that this kind of learning can only be done in the context of concrete actions. That is to say that limited actions and positive achievements must be realized, capitalized and diffused. Such considerations are directly linked to the cognitive processes we use in cognitive activity. That is why we propose to name such competences as "cognitive competences". It is desirable to develop the positive aspects of things in the face of "mutual holding back systems" linked with top-down organization.

Applying a dialogic approach to cognitive competencies

To some extent, the issues we are dealing with require encouragement of local initiatives and actions in the face of immobility, submissiveness and negative mindsets usually developed by traditional organizational modes. As long as activities are organised in a top-down way, as long as execution is limited to the operational levels and reflection, design and control are the preserve of the higher levels of organizational pyramid then the development, involvement, feelings of belongings and optimistic behaviour may be difficult to achieve. Such organizational modes are considered as producers of "mutual holding-back systems" and in return are reinforced by it.

Local initiatives, i.e. disequilibrium and disorder are desirable for innovation and change. It is impossible, or at least dangerous, to act as if the ambient negativity and its related behaviours are not at work. In fact, this negativity is made of several ingredients i.e. positive valuation of order and equilibrium, reluctance to change, fear for the future (uncertainty), submissiveness, reluctance to take on responsibilities, etc. To our way of thinking using an epistemological mode of reasoning, issues have to be defined in a dialogical way; both must be considered as acting in conflict and in mutual co-production relationships.

The role of the leader or manager is critical in these developments. They must be aware of their starting points. They have to encourage local initiatives and small improvements in order to make their teams move in a positive way, and to generate positive mental representations in their minds. At the same time, they must also conserve or develop this in-tune with parts of organizational order which is necessary in order to stay at the edge of chaos but not to anarchy. Tuning order with disorder is an important part of their art of management. It remains a question of on-going personal learning.

IV. Conclusion

There is no generic or recurrent method for facilitating and managing innovation activities. In this paper we examined the current research and concluded that they are inconsistent with our own research. Our research suggests that we need to address two opposing and contradictory principle at the same time. They are the order and disorder principles. Since Positivistic epistemology cannot address these contradictions, we proposed the use of Morin's "dialogy" concept as a way of addressing the challenge.

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Managing collaborative e-business and e-manufacturing through distributed environments

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Abstract:

The present paper focuses on the topics of collaborative e- business, collaborative e- manufacturing and Virtual Enterprises in distributed environments. It is based mainly on the Europe&Asia Link project WECIDM (ASI/B7-301/3152-99/72553) starting in January 2004 and the Collective project KNOW-CONSTRUCT (COLL-CT-2004-500276) starting in March 2004.
WECIDM project aims to develop an internet-based platform that allows a distributed team to perform a collaborative design in which the knowledge from different parts of the value chain, like design rules imposed by the manufacturing process, since most of the design and manufacturing management systems of an enterprise do not consider all the involved product/process knowledge from the whole value chain.
KNOW-CONSTRUCT project aims to develop a common internet-based platform for SMEs from the construction sector to provide an effective combination of two general functionalities: an innovative decision making support system regarding the products characteristics, applications and other consultancy services for SMEs' customers applying the "web enabled dialogue", and a system for SMEs to support an advanced form of co-operation through the creation of Knowledge Communities of SMEs.

Keywords: Working Communities, Distributed Design-Manufacturing, Ontology, Knowledge Management.

I. Introduction

Collaborative product design and manufacturing among distributed teams through the Internet is becoming more necessary as enterprises are distributing their activities throughout the world. In addition, SMEs need to improve communication with their customers in order to provide better product support and services.

Classical simple Internet solutions often do not satisfy the needs of the SMEs. The support to integrated teams creation through an integrated and well tailored IT approach can lead to crucial advancing in business area.

Application of the state-of-the-art ICT solutions is necessary to assure higher efficiency of the co-operation and integration processes. Necessity of knowledge and competence integration for a successful responding to customers needs imposes a need of establishing the knowledge communities of SMEs.

The systems presented support the integration, management and reuse of knowledge via a common knowledge base, in a form of essential expertise, reachable anywhere, at any time.

II. e-business: KNOW-CONSTRUCT

1. Introduction

The construction sector is characterised by a high level of fragmentation, with a large number of participants in each construction project, being the large majority SMEs. A narrow technical specialisation must be replaced by significantly wider technical competence through integrated teams as knowledge communities, followed by on time, within budget works completion. Taking into account these needs the consortium comprising Construction Industry Associations, SMEs from the same area and RTD organisations from four European countries decided to initiate the research project with a main goal defined as development of an innovative solution of Internet Platform for Knowledge-based Customer Needs Management (CNM) and for Knowledge Communities Support (KCS) for SMEs in Construction Industry. It was identified that the professional associations may represent an ideal environment to provide such a solution. In order to successfully meet the challenges described, the KNOW-

CONSTRUCT project [1] consortium has defined its main objective as the development of a common platform for knowledge based systems, which provides a combination of two general functionalities:

(a) **Customer Needs Management (CNM) System as** an innovative decision making support system regarding the product characteristics, product applications and related consultancy services, and

(b) **Knowledge Community Support (KCS) System** as a System to support an advanced and efficient formation of communities of SMEs in construction industry, through their specific knowledge integration, management and reuse via a common knowledge base.

The business objectives can be summarised as improved innovative technical support to product and service users, wider technical competence required to satisfy customer needs through closer co-operation and knowledge exchange among SMEs within knowledge communities, including improved quality/price ratio and on time completion of increasingly complex tasks. This innovative system provides ontology based semantic features, allowing knowledge be available in a form of essential expertise, reachable anywhere, at any time.

2. Innovation

Starting from the stated business and technical objectives and basing on the analysis of the state-of-the-art and current standards [2][3], the main problems addressed leading to innovations are: Methods for creation of Knowledge Communities of SMEs in construction industry, to establish or re-use an adequate domain related ontology [4], as well as classification system for this sector applicable in SMEs environment, an inter-organisational practicable knowledge management system for Construction Industry Knowledge Communities, new forms for a representation of the experience-based knowledge, to provide a "web based dialogue" between SMEs and their customers aiming at an interactive decision support tool to be used for customer problem solving.

3. Research approach

KNOW-CONSTRUCT does not develop new methods but re-uses the most appropriate ones and enhance/adopt them for specific e-support needs for SMEs.

- **Methodology for Establishment of Knowledge Communities:** The methodology for creation of the SME Knowledge Communities in the construction sector is elaborated with emphasis on knowledge representation and ontology issues.
- **Approach for Knowledge Representation and Ontologies:** To apply adequate domain related **ontology**, as well as **classification system** for this sector applicable in SMEs environment. Solutions applied within e-COGNOS are partially re-used.
- **KB Meta Model:** KNOW-CONSTRUCT creates a meta model for structuring the domain knowledge and for setting repositories to store Construction Industry Knowledge (CIK) on products, processes, problems, best practices, legislative issues, experience etc. as needed for both e-CNM and e-KCS functionalities.

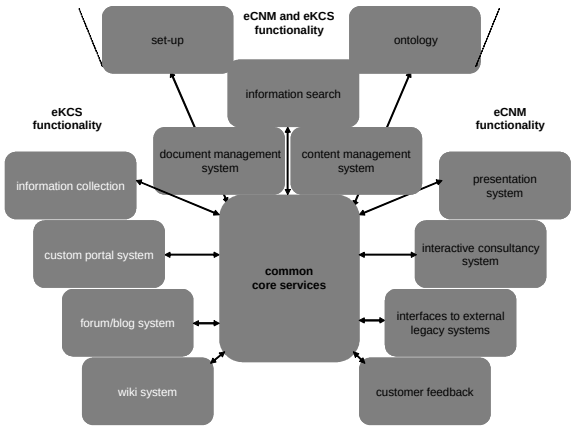

Figure 1: Overall Functional Architecture of KNOW-CONSTRUCT System

The overall functional architecture of the system is represented in figure 1 above, being the main functionalities of both CNM and KCS modules the following:

CNM - Customer Needs Management

- Browsing community resources: facilities to browse information about the companies belonging to the community: Products, services, procedures, etc.
- General Browsing: facilities to browse in a structured way through the information made available for the customers.
- Searching materials/products/components/procedures: facilities to search information and knowledge related to materials.
- Searching services/domain/context: facilities to search knowledge related to services.
- Interactive, web-based consultancy: tools to help customers to solve problems.

KCS - Knowledge Community Support

- Knowledge sharing: tools to collect, disseminate and search experiences, problems, best-practices, opinions with the community.
- Knowledge community building: tools to create and share knowledge through collaboration, like discussion forums, twiki tools, news services, etc.
- Content management: tools to classify, organize, search documents, etc.
- Knowledge structure management: tools to manage ontologies and classifications schemes.
- Information collector: collection and organization of information from external sites.
- External search manager: complement searches in the knowledge community with searches to external sites, portals, databases, etc.

Semantic web technologies are fundamental for eKCS in order to provide complex information retrieval, both internally and externally to the knowledge community. The eKCS core services are divided in *Semantic Resource Management* and a set of functionalities that provide the systems/applications with access to the semantic resources, namely: Ontology manager, Indexing and knowledge extraction, Semantic searching and navigation, Aggregator/integrator, Business data model wrapper.

III. e-Manufacturing: WECIDM

Collaboration is particularly vital for product design since this upstream activity in the product life cycle has a decisive impact on the success of the particular product [5], [6]. In addition, it is not possible to fulfil the new requirements solely based on conventional CAD-CAE systems and the present Internet facilities [7]. New infrastructure, tools, methods and knowledge are needed, a distributed cooperative product design capability is necessary.

Currently most of the design and manufacturing management systems of an enterprise deal with local and static database systems and do not consider all the involved product/process knowledge from the whole value chain. The approach presented mainly focuses on those techniques that can support multi distributed clients and provide a dynamic database service, thus making possible a dynamic distributed design and manufacturing process.

The core application of the system presented manages the distributed design and manufacturing process through the internet between different teams, including the management of all the relevant product knowledge for design and manufacturing processes. The basic structure of the system developed for distributed product design and manufacturing is described, which includes Dynamic Database, Product Data Management (PDM) and Knowledge Based Engineering (KBE) modules.

Different CAD and CAM users interact with the server through the Middleware. The server includes a software application which performs the basic PDM features and interacts with the Dynamic Database, residing in the server as well, thus centralizing the design and manufacturing process. This “central server” contains all the project information, i.e., every file related to the product (geometry, process parameters, etc) and external users can interact with it through this specific PDM application.

There are specific KBE modules for specific part families and production processes. Different KBE modules are available for different kinds of parts and production processes (such as forging, machining, etc.) since different processes have different type of rules related. The set of rules includes the necessary “knowledge” for the complete design and manufacture of the part.

On the other hand API applications are developed for specific CAD users packages, so that design rules can automatically be applied by the CAD users in their local CAD system.

The main modules developed for this prototype are the PDM application and the KBE modules for the manufacturing processes considered, both residing in a central Server.

1. Product Data Management (PDM)

This application performs the basic product data management features and manages the KBE modules and the Dynamic Database. Modifications in the files and databases in the Server are done hierarchically and controlled by this PDM application. An assembly may be composed of different sub-assemblies, each of one is in turn composed of different parts. Every part has different files associated, corresponding to geometry, CAM files as well as any other file containing information relevant to the design and manufacturing process for that part. This PDM application is linked to a MS Access database where all the relevant information related to the assemblies, parts and documents is stored. This database cannot be directly seen by the user, whose only interaction with it is through the PDM tool.

2. Knowledge Based Engineering (KBE)

KBE allows companies to capture and reuse the knowledge and experience of their engineers, together with manufacturing best practice, legislation, costing, and other rules for the product development. In this system prototype, different modules are developed for each process and for each part family, in order to implement the specific design rules and process parameters. These modules are implemented in connection with the dynamic database where the design rules parameters values are stored.

Designers can in this way get the parameters values in order to apply the design rules in the product design. These data will be automatically used inside the CAD system through the appropriate API application developed for that specific CAD package.

Figure 2 shows the graphical user interface that allows an authorised external user to read or write the values of some design rules parameters corresponding to a typical forging process. These parameters are such as: flash land geometry, preform volume, draft angles, convex radius.

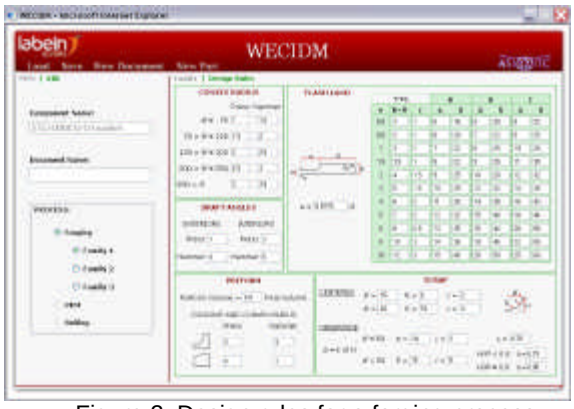

Figure 2. Design rules for a forging process

Using the specific case of forging part design and manufacturing as example, the distributed design and manufacturing methodology through the tool developed would be the following.

Manufacturers introduce or modify the design rules parameters. Designers will be able to get automatically a design in their local CAD system incorporating the design rules selecting the specific forging family, part dimensions and process options in the user interface like that shown in figure 2. This information (family type, part dimensions and process options) will be stored in a file residing in the central server that the designer can download. This file will contain as well the current design rules imposed by the manufacturer, and, in this way the designer can automatically incorporate the manufacturing rules in the design.

For the CAD user to be able to apply the process and geometric information automatically in the CAD package, a CAD parametric “template” must have been developed for that CAD package and that particular family. The CAD model is thus generated applying the information introduced by remote users, and therefore fulfils the forging design rules imposed by the manufacturer.

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Meta-modelling "object": expression of semantic constraints in complex data structure

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Abstract: To manage parameters, the majority of Information Systems is concerned by heterogeneity in both data and solutions. Consequently, the management of this data becomes complex, inefficient, insecure and expensive. In this paper, we suggest a solution based on XML architecture developed by Orchestra Networks. This architecture allows Master Data Management in the Information System. The unification of Master Data is primarily done by the definition of models in our solution. These models are XML Schema documents, describing the definition of complex data structures. We propose to enrich the structure and the semantics of these models by defining a metamodel. In the metamodel we introduce semantic object relations in order to define links between concepts. The resulting metamodel is used to optimize operations such as models validation, data factorisation and trees optimisation.

Keywords: interoperability, Master Data Management, Metamodel, Metaschema XML, XSD Language

I. Introduction

Within the framework of the interoperability of heterogeneous data sources, two main data integration approaches exist: the materialized approach (or data warehouse) and the virtual approach (or mediator) (Lenzerini 2002). We suggest an implementation of the second approach by an XML architecture called EBX.Platform. This architecture allows companies to unify the management of their strategic data without any changes in their databases or their existing applications. This unification is conducted in three ways: (i) Definition of the main data model through the XML Schema language. (ii) Persistence in a common repository, specific to the product, in a remote or integrated database. (iii) Avaibility of a generic user-friendly web tool interface for data consulting, for updating and for synchronizing the repository with the Information System of the companies.

One of the major added values of EBX.Platform for companies is that the repository manages the notion of inheritance of instances. The data factorisation abilities brought by inheritance and by EBX allow data duplication and related problems (costs and risks) to be avoided. To implement the mechanism of inheritance, a first conceptual model has been realised. Specific difficulties remain on various points: respect of the integrity constraints according to the operations carried out (such as creation and deletion of occurrences), management of impact related to inheritance, definition of automatic algorithms of optimisation by factorisation. This paper presents the consolidation of the conceptual model by the definition of an object metamodel, by using existing research in this field or in related domains in order to propose a few operational solutions.

II. EBX Platform

The company Orchestra Networks proposes Master Data Management software called EBX.Platform. Based on Java and XML Schema, EBX.Platform is a standard and non-intrusive solution that helps companies unify and manage their reference business data and parameters across their Information System. EBX.Platform is based on two concepts: **(i) an adaptation model** which is a data model for a set of Master Data. It is an XML Schema document and **(ii) an adaptation** which is an XML instance of the adaptation model which contains Master Data Values. Using XML Schema allows each node of the data model corresponds to an existing datatype according to the W3C standard (W3C, 2004) to be specified. EBX.Platform supports the main XML Schema datatypes, as well as multi-occurrence complex types. Indeed, the XML Schema formalism allows us constraints (enumeration, length, lower and higher limit, etc.),

information about adaptation and its instances (access connector, Java factory class, access restriction, etc.) and layout information (label, description, formatting…) to be specified for each node of the schema. For each node of the adaptation model, declared possible instances, corresponds a node in the adaptation. If an adaptation model has several adaptations, we consider that an adaptation tree is handled (cf. figure 1)

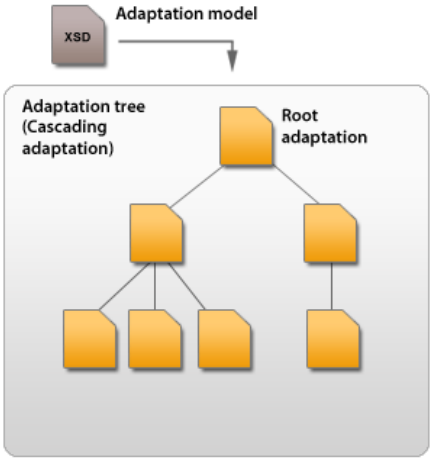

Figure 1. An adaptation model and its intances

In an adaptation, each node has the following properties: **(i) An adaptation value**; if this value is not defined in the current adaptation then it is inherited from its ancestor (parent adaptation), recursively. If no ancestor defines a value, then the value is inherited, by default, from the data model. **(ii) An access right** for descendants; the adaptation node can be either hidden (to descendants), in read only (for the descendants), or in read/write (for the descendants).

III. Meta-modelling "object"

We introduce object features which are added to the conceptual model and we propose a metaschema of an adaptation model, in order to consolidate both the conceptual model and the existing data validation. Our first goal is to add object metadata to the adaptation model. We can use the following notions in terms of relations between objects: generalisation, specialisation and dependence (aggregation or composition). To illustrate these concepts, let's take an example frequently used in some UML academic cases. This example defines five concepts: *Person*, *Teacher*, *Student*, *University* and *Department*. These concepts are semantically linked. More precisely the concept *Person* is the generalisation of *Student* and *Teacher*, and the concept *University* is a composition of *Departments.* These semantic links have strong impacts in data factorisation and optimisation. Moreover, the composition hypothesis between concepts has as the consequence of creating a strong dependency between these ones. Let us consider in our example the notion of dependence (more precisely the composition) between *University* and *Department* concepts. The composition implies that there cannot be instances of the *Department* concept without instances of the *University* concept. An optimisation can be made for the instance deletion process: the deletion of an instance of the *University* concept implies that all dependent instances (*departments*) will be removed. However, in the case of an aggregation between these concepts, the aggregated instances (*departments*) will not be deleted if they are used by other concepts.

Generalisation and *specialisation* relations are used to factorise data in our system. In the generalisation case, common attributes are gathered in a general concept. For example, attributes such as *firstname* and *lastname* are common to the concepts *Student* and *Teacher.* To factorise data these two attributes are migrated to the concept *Person*, avoiding the duplication of their definition in the concepts *Student* and *Teacher.* In the same way as (Zerdazi and Lamolle, 2005), we propose some metadata to be included in the XML schema to implement these notions. As W3C suggests it, the XML Schema extensions that we design are

defined in the « *appInfo* » element as in the following example about the above composition between *University* and *Department*:

```
<xs:complexType name="University">
…. <xs:annotation>
        <xs:appinfo>
                <osd:composition>
                        <osd:conceptPath>
                                Path of department's concept in the schema
                        </osd:conceptPath>
                </osd:composition >
        </xs:appinfo>
    </xs: annotation >….
</xs: complexType >
```

Facets and concepts have been defined parsable by EBX.Platform. By defining XML Schema extensions in the elements *annotation* and *appInfo*, it is not necessary to provide a schema allowing the structure of these facets to be defined. One of the resulting issues is that the validation of these extensions is fully delegated to the validation engine of EBX.Platform, and not to thev XML Schema engine. We have defined a metaschema of an adaptation model describing the structure of the concepts provided by EBX.Platform to avoid this issue.

IV. Definition of an UML profile

The definition of an adaptation model is made through the XML Schema technology. XML use is adapted to the needs of EBX.Platform which implies a wide knowledge of this language. There are many XML Schema tools; on the one hand the user can use the XML Schema features which are not implemented by EBX and on the other hand he is not guided about the extensions of EBX. As a result, formalism must be used to make this modelling easier. In addition to its modelling abilities, UML allows profiles (Mahmoud 2003) (Pilone and Pitman 2006) to be defined. A profile specialises the UML formalism for an application field or a particular technology. Many profiles have been developed, for example CORBA and EJB. After studying the XML metaschema, we deduced a UML profile defining relations between the different concepts introduced by EBX (see figure 2)

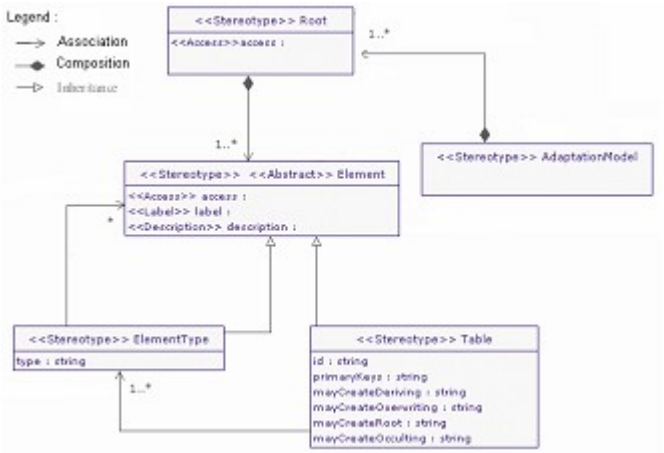

Figure 2. Extract of UML profile representing EBX.platform metamodel

By defining a metamodel, we improve the process of data validation which enables us to use the XML schema validation engine in an automatic way. Moreover, the definition of a UML profile allows us to ensure that the designer uses the semantic strictly defined by EBX.Platform, avoiding some XML Schema specificities which are not managed. We associate a generator of XML Schema code to this UML profile which makes the definition of an adaptation model easier and more secure.

V. Conclusions and perspectives

We have seen that every EBX model is an XML Schema standard document. This point can be specified in this way: only a subset of the XML Schema language is implemented by EBX. Some XML Schema features are difficult to handle for the designer of the adaptation models. They would not bring a significant added value to EBX.Platform. The extension possibilities of XML Schema are used for example for dynamic constraints or for enumeration labels. The following needs can be deducted:

- EBX models designing and validation should be better supported. Some XML Schema tools exist. But the designer can use all XML Schema features which are not implemented by EBX. On the other hand, the EBX extensions are not known to him (he has to use a non-attended XML verbose text mode). We have proposed a metamodel to validate adaptation models in a transparent way by using the XML Schema validation engine in this paper.
- The third party tool allows only a very partial validation. As presented, the use of UML profiles is means chosen to solve this problem.

The follow-up to this work will be the enrichment of our metamodel for the Master Data Management module, allowing semantic constraints) to be expressed and validated according to profiles (for example business language. We will develop two axes:

- modelling methods and constraints expression (expression of facets): formalism design as UML will allow EBX schema modelling. The created schema is valided by this modelisation based on rules.
- Constraints expression integration according to profiles (constraints on types or between concepts). This notion supports a semantic to the represented concepts and expressions of dependency.

We will take into consideration the ODMG standard features (ODMG, 1999) to EBX formalism (inheritance notion about the models, directly specified in the schema, such as specialisation, generalisation, dependence, etc.), UML formalism, the advantages related to the OWL language dedicated to the ontology definition (Kalfoglou and Schorlemmer, 2003), and the advantages of conceptual graphs for the expression of relations and of constraints between concepts.

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Innovation models and processes: a recipe to be competitive now and in the future

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Abstract: Innovation is widely recognized as an adequate 'tool' to gain competitiveness and it's often defined as an idea, process, service, product, etc., that is characterized for being new and commercially accepted. The description of the innovation process as a sequence of tasks (or as a series of loops that give feedback) is not new; but there is not still an easy way to materialize these processes into the industry. Various authors have defined modelling as the most adequate way to achieve this purpose. In this sense, there are many examples of models during the last decades that can be categorized by types, functions and number of stages. This paper compiles and summarizes all most relevant models published during the last three decades. It also identifies their key factors, which are included in a questionnaire that will be used amongst the chief managers of relevant industrial firms in the Basque Country in order to gather industrial opinion about the necessary information for characterizing a new innovation model. The originality of this work will be the joint development and validation of a new innovation model between academia and industry, suited to actual needs; agile and customized to industrial companies.

Keywords: INNOVATION, MODELS, KEY FACTORS, COMPETITIVENESS, SURVEY

I. Introduction

The main objective of this work is to define a customized innovation model for the industrial firms of the Basque Country, based on the literature on one hand and in our future customer's needs in the other. In this sense, this paper presents the first step given within this work and it plans the missing ones as next steps.

This paper is structured as follows. First it summarizes the definitions of innovation and model. It continues presenting a review of the innovation models found across the last 3 decades (1976-2006) and a summary of the key factors that an innovation model should include. Next, it extracts the conclusions according to previous work and presents the next steps to be done to define a validated innovation model.

II. Innovation and models. Definitions.

Innovation is a widely utilized and defined word, both by practitioners and scholars. The definition made by Schumpeter in 1934 (Escorsa & Valls 1997) considers the introduction into the marketplace of a new good or production method, the creation of a new market, the finding of a new raw material provider or the implementation of a new structure in a market. Padmore, Schuetze, & Gibson (1998) go on with this philosophy, and define it as any change in the inputs, methods or outputs that manages to improve the commercial position of a firm and that is good for its actual market. Aiken & Hage (1971) leave market aside and consider innovation as the generation, acceptation and implementation of new ideas, processes, products or services first in an organization, and Damanpour (1992) defines it as the adoption of an idea or behaviour that is new to the adopting organization. Gee (1981) and Pavon & Goodman (1981) add the process concept to these definitions, and in the same way, Amabile (1988) adds creativity and Tang (1998) adds the project concept. One of the last contributions is the one made by Galanakis (2005), who speaks about scientific or technological knowledge as the raw material or input for an innovation. In this work, innovation is understood as an idea, process, system, method, service, product, policy, etc. that is characterized for being new or improved and commercially accepted.

At the simplest level, a model is a representation of something (Mitchell 1993). J. Pidd completes this definition stating that a model is an external and explicit representation of a part of reality, as it is seen by individuals who wish to use it to understand, change, manage and control that part of reality (Pidd 1996). Within this work, a model is understood as a representation of the facts needed to complete a process, in this case, the innovation process.

Models can be classified according to their type or function. According to the type, an accepted taxonomy is given by Saren (1984), who identifies 5 types of innovation models: Departmental stage-models, Activity stage-models, Decision stage-models, Conversion process models and Response models. According to the function, the chosen reference has been Walliser's classification (Walliser 1977), where four different functions are identified: Cognitive function, Predictive function, Decision-Making function and Normative function.

III. Review of the innovation models

In the last three decades have been many models of the process of innovation. A total amount of over 70 reports and articles have been found and analyzed, although 35 of them, and the 40 models described within these reports and articles have been deeply analyzed. The reason for that is basically that some of them are reviews, others present mathematical, statistical or simulation models, which are not the kind of models this work is looking for. Mainly, the interest of this work is on theoretical or practical models oriented to industrial firms. The authors have focused on the next five elements for doing the analysis; model type, the model's function, nº of stages presented, the input/output of the model and the innovation concept.

1. Three decades, three stages

A total amount of 40 innovation models have been analyzed and divided in three groups, a group for each decade, so that a 30 year study have been done. Each group has been named according to the concept of innovation concluded from the definitions made by the authors, being; the traditional stage, the process-creativity stage and the process-knowledge stage

As it can be seen in **Erreur ! Source du renvoi introuvable.**, the dominant type of model is the activity-stage one, that can be defined as a model that identifies particular activities that are performed during the innovation process, and in some cases can illustrate "feedback loops" within stages (Saren 1984). Conversion process models have had a raising evolution through the last years, moving from three to seven, so that they are becoming more and more popular among researches. This type of model is described as the model that considers the innovation process as a "system" in terms of inputs and outputs. It avoids the sequential approach of other models where one stage follows the other, the order is unspecified (Saren 1984). Even though most of the models were easily typified, some of them seemed to belong to two types of models, so that is has been the author's decision to include them in a type or in another.

According to the function the model is useful for, it's clear that the cognitive function is the most representative of the models studied. With the exception of the traditional stage, where decision making or normative function models could be found, the remaining ones had a cognitive function. This function was widely defined by Walliser, who stated that a cognitive model must supply an as good as possible relation between the inputs and outputs of the modelised system and specially, it must add the relative influence of the diverse input variables (Walliser 1977).

The number of stages illustrated in the different models is not really relevant, but it has been useful to determine that, even though this number varies from a minimum of three to a maximum of nine, it can be easily identified that nearly all of them can be simplified to three or four main stages, which are: 1- Research or analysis both indoor and outdoor looking for an opportunity/idea to develop, 2- The development process of this opportunity/idea, 3- A feedback stage to modify and/or apply learned things to the development process, and 4- The marketing or market launch of the generated innovation. Once again it's worth to mention that these stages do not have to be sequential, but the order must be defined by the innovator (person or group), so that the innovation process is understood as a continuous process.

		1976-1986 ***Traditional stage***	1986-1996 ***Process-creativity***	1996-2006 ***Process-knowledge***
Number of models		12	8	20
Type (Saren, 1988)	Departmental-stage	1 (8,33%)	1 (12,5%)	2 (10%)
	Activity-stage	7 (58,3%)	2 (25%)	8 (40%)
	Decision-stage	1 (8,33%)	1 (12,5%)	2 (10%)
	Conversion process	3 (25%)	4 (50%)	7 (35%)
	Response model	-	-	1 (5%)
Function (Walliser, 1977)	Cognitive	9 (75%)	8 (100%)	20 (100%)
	Predictive	-	-	-
	Decision making	2 (16,67%)	-	-
	Normative	1 (8,33%)	-	-
Number of stages	Min. / Max.	3 / 9	3 / 5	3 / 9
	Most common	3 or 5	3	3 or 5
Input	Organizational characteristics	+ idea	+ innovation + idea	+ knowledge
	Environment			
Output		New product	New product, process or service. Success or failure of the innovation	New product, process or service. Knowledge or experience
Innovation concept		Novelty	Process Exception: Ram (1987), "a product which is perceived by consumer as new"	Process for obtaining new or improved ideas or solutions.

Table 1: Temporary evolution of model's characteristics.

Even though the key inputs and outputs of each model don't vary too much among the three stages, **Erreur ! Source du renvoi introuvable.** shows how they have evolved. Referring to the inputs, most of them can be classified into organisational characteristics, i.e. structure or capability, technology, resources, and environmental factors, as the demand or need of the market/customer, but intangible factors like the idea or knowledge have been incorporated in the last years giving them a different character. Outputs are also quite reiterative and they are defined as new or improved products, processes or services launched into the marketplace, but as the inputs do, they have also moved into knowledge or experience.

2. Key factors

The key factors affecting the innovation process is a widely developed subject. This paper wants to compile and classify them, finding the key factors identified by the analyzed model's authors, so that it's supposed they've been looking for the critical factors both for the innovation process and for their model to success. All the key factors identified are illustrated in **Table 1**.

The factors have been classified according to the widely accepted McKinsey's 7Ss framework (Peters & Waterman 1984); skills, strategy, structure, shared values, style, staff and systems. This framework has been completed with an eighth type, the environment or context, considered important by many authors (Cummings & O'Connell 1978; Miller & Friesen 1982; Miller & Blais 1993; Damanpour & Gopalakrishnan 1998; Tang 1998; Bessant et al. 2005; Smoot & Strong 2006).

IV. Conclusions and next steps

The analysis made shows that the quantity of models has varied through the last 3 decades, from 12 to 8 and to 20 in the last years. This fact can be understood as the existence of a growing interest within this subject by academia and certainly by organizations, who are the final users of these models. But what worries about it, it's the very little differences found among the models in the seventies and in the new century. Why is there so little change among the models? and then, why are there so many models developed? This question was already asked in the seventies by Lilien G.L. (1975 in Landry, Banville, & Oral 1996), who referring to the OR(Operational Research) literature asked: "Why are so many models built and so few used?". Maybe R.G. Cooper (1983) was right when trying to determine the average process for developing new products, concluded that the notion of a generalized or average process is indeed misleading. In fact, he found seven different models within 30 firms. This can be the

main reason of why so many models are developed; almost every firm needs its own model, its own customized innovation model.

TYPE	FACTORS	AUTHORS
Skills	Technological capabilities	Cummings&O'Connel (1978); Tidd et al. (1997), Burgelman et al. (1996); Cooper (1999) in Galanakis (2005)
	Size of R&D activity, nº of technologies, nº of units involved in R&D activities	Baker&Sweeney (1978)
Strategy	Mission, goals and strategies	Tang(1998);Cummings&O'Connel(1978); Cormican&O'Sullivan(2004);Cotec(2006)
	Strong market orientation	Rothwell (1992); Johnson et al. (2004)
	Referring to the innovation it self: Uniqueness and superiority	Smoot&Strong (2006); Cooper (1980); Rogers (1983)
	Stage of the product life cycle	Smoot&Strong(2006);Schmidt&Tiedeman (1982)
	Technical and production synergies	Cooper (1980)
	Cost and performance	Saren(1990)
	Quality, integrity, effectiveness	Johnson et al. (2004)
	Compatibility, complexity, divisibility, communicability	Rogers (1983)
Structure Smoot&Strong (2006) Tidd et al. (1997) in Galanakis (2005) Berstein&Singh (2000) Cummings&O'Connel(1978) Cormican&O'Sullivan(2004)	Complexity, diversity and formalization	Baker&Sweeny (1978)
	Centralization	Baker&Sweeny(1978);Millr&Friesen(1982)
	Size (sales per year)	Cooper (1983)
	Technocratization, differentiation, integration	Miller&Friesen (1982)
	Personal	Tang (1998); Smoot&Strong (2006)
	Finance and equipment	Tang (1998)
Shared values	Mission, goals and strategies	Tang (1998); Cummings&O'Connel (1978); Cormican&O'Sullivan(2004)
	Good internal and external communication	Rothwell (1992)
Style Berstein&Singh (2000) Udwadia (1990) Cotec (2006)	Leadership	Cormican&O'Sullivan(2004);Larrea(2005)
	Quality management; dynamic, open-minded	Rothwell (1992)
	Risk taking policy	Tidd et al. (1997) in Galanakis (2005); Miller&Friesen (1982)
	Good internal and external communication	Rothwell (1992); Cotec (2006)
	Communication and collaboration	Berstein&Singh (2000); Cormican&O'Sullivan (2004)
	Empowerment	Sundbo (1996)
Staff	Degree of creativity	Tidd et al. (1997) in Galanakis (2005)
	Expertise	Tang (1998); Johnson et al. (2004)
Systems	nº of innovation phases	Baker&Sweeney (1978)
	Extent of contribution to goals and objectives	
	Information processing, Decision making	Miller&Friesen (1982)
	Innovation as a corporate wide task Providing good technical service	Rothwell (1992)
	Product champions,technological-gatekeepers	Rothwell (1992); Johnson et al. (2004)
	Careful planning and control procedures	Rothwell (1992); Johnson et al (2004);Galanakis(2005);Cormican& O'Sullivan(2004);Cotec(2006)
	Efficiency in development work and high quality control	Rothwell (1992); Tidd et al. (1997) in Galanakis (2005); Galanakis (2005); Bernstein&Singh (2006)
Environment/Context	Level of uncertainty: technical and economic	Baker&Sweeny (1978)
	Dynamism, heterogeneity and hostility	Miller&Friesen (1982)
	Nature of market; need intensity, growth rate and size	Cooper (1980); Cooper (1999) in Galanakis (2005); Smoot&Strong (2006)
	Critical mass of suppliers Distribution infrastructure in marketplace	Burgelman et al(1996) in Galanakis(2005)
	Politics; economics	Tang (1998)
	Society	Tang (1998); Udwadia (1990
	Increased world competition	Cooper (1999) in Galanakis (2005)

Table 2: Key factors identified through the analysis of models' literature.

The main conclusion of this review is that although there are many innovation models developed, most of them show a similar baseline, and the main difference states in the particularities incorporated in the model in each particular case. Another conclusion is that different factors are becoming more and more important in the innovation management literature through the three stages. These are creativity and knowledge, both directly related with human behaviour or human resource management, another concept that is present in

every organization and that is defined as an important key factor for the success of the innovation process (Galbraight (1984) and Vrakking (1990) in Jimenez-Jimenez & Sanz-Valle 2005).

The work compiled in this paper will serve first to prepare a questionnaire that will be used amongst the chief managers of relevant industrial firms in the Basque Country. This questionnaire will be used to gather industrial opinion about the necessary information for characterizing a new innovation model, that according to the conclusions extracted within this paper will be suited to actual needs, agile and customized to industrial companies.

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A Systemic Methodology for Facilitating Service Innovations

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Abstract: In this paper we will present a methodology that provides a framework to facilitate service innovations and to develop services in business to business environments. Service innovations being systemic processes create ripples throughout the organization as well as over organisational borders. Therefore, the complexity of this phenomenon needs to be subdivided into accessible parts of the whole in order to be effectively followed and managed. We have used a common three level model of organisations but based on our case studies identified ten focus areas to manage service innovation process. These areas are (at the strategic level) strategic positioning, co-operation patterning and value constellation, (at the business process level) business process drivers, collaborative business processes and value capturing, (at the operational level) specification, organizing, task flow and value maximization. Business to business services often interconnect organizations' core processes. Tuning this type of service to provide maximum value to the customer is an iterative and cyclic process. Using pilots to develop and test focus areas provides rapid evidence based knowledge and also experience about cooperation between organizations. Using both a focus area approach and pilots provides a systemic methodology to define the actions required to identify and create service business in supplier-customer collaboration.

Keywords: service business, systemic, innovation, development, methodology

I. Introduction

In this paper we outline a methodology for facilitating service innovations and for supporting service business development in a service integrator – customer interface. Herein the service integrator is the service provider towards the customer. Behind an integrator company, there are often a number of other companies that provide their expertise to the service process. The difference between the integrator and these other companies is that the service integrator owns the customership. The methodological approach and framework that we present can also be used to describe the transformation and collaboration between the integrator and other companies if necessary. The described framework is based on research that is conducted in the BeSeL project, where we approach service innovations mostly from business logic, business model, business process and earning viewpoint while the information flow level service process is paid less attention to. The focus of the paper is on business to business services by technology industry companies that enlarge their offerings more towards services.

We first open up the background for our approach from innovation viewpoint and then we describe the suggested framework. Another aim of this paper is to clarify the fuzzy concept of a "service innovation" – a word often used by industry, but only seldom properly defined.

II. Focus of Service Business

Innovations and innovativeness has been in the centre of recent public discussions, where however, the term has often been used quite carelessly without properly defining it. As an example, people often talk about innovations while they actually talk only about ideas. Thus, we would firstly like to state that innovation is a successful idea and with successfulness we understand that the idea has proven commercially sustainable.

In many branches of the technology industry, the products and the technologies underlying the products have become commodities. Differentiation with new technological solutions has become difficult, as it is also difficult to maintain the profits in a product centric business. Providing services instead of products enables taking a larger share in supporting customer

value creation. While in product based business the interaction is limited to sales-purchases transaction, in services the interaction between the customer and supplier is a collaboration process. Thus, many companies have started to search profitable growth from service business.

Depending of supplier (and also market) strategic positioning, the services can be positioned in the product – service continuum, yet companies seldom operate in neither of the ends. However, in order to illustrate the change of the service focus, we identify below five simplified positions (an example of quite similar positioning can be found in Kalliokoski et al. 2000):

1. Product centric support for the products. These services typically exist only to support the product sales for which they are often a must. Examples of such services are spare parts, calibration and training. In some cases (e.g. spare parts) it is often criticized whether these can be considered as services at all.
2. Transactional services that support the installed base over its lifetime. Examples of this kind of services are maintenance projects/tasks, repair, help desk. These services are one-off transactions and thus close to the product centric business model.
3. Offering that is relationship based and has a focus on customer operations. These aim to support value creation on operative processes' level. The emphasis is often on existing processes in contrast to developing new processes in which the value is co-created.
4. Offering that is relationship based that focus on customer business processes. These services aim to support customer business by co-creation of value.
5. Taking over all operations (this can also be considered as a thread by customers).

Positions 1 and 2 represent services near the product centric end of the continuum and the services focus typically on supplier's product and, thus, the direct recipient of the service is the product, not the customer as explained by Mathieu (Mathieu 2001). He also identifies a case where the recipient for a service is the action of the client. In our positioning numbers 3 and 4 can be considered this kind of services, but of course the interaction is in 3 and especially in 4 more wide-ranging than only a single action (or even actions) related to using a product. Prahalad and Ramaswamy, (2004) Grönroos (e.g. 2000) discuss joint processes between the service provider and the customer, that support the customer value creation.

III. Approaches for the Innovations in Practice

There are implications of three basic cases (e.g. Norman 2001, Boyer 2004, Tanayama Tanja 2002, Chesbrough 2003) for innovations, applicable also to developing a new service business. There may be links between the identified cases and the focus of service business: push model and product centric may be a traditional approach in the technology industry, while in service business the pull and interaction models might be more beneficial. The identified cases are:

1. In a *push model* the customer is considered as a recipient. The supplier develops his offering for the market. The model is based on a production centric model (e.g. Pulkkinen et al. 2005), where the productivity and efficiency objectives of the supplier are emphasised. Though increased productivity and efficiency in producing the offering is often seen as the key to customer value creation, the factors which really contribute to the customer value creation are not thoroughly addressed. This model often involves a traditional strategy planning and aims at controllin production and sub-contracting processes.
2. A *demand or pull model* that considers the customer as a source for needs. Suppliers in this model aim at listening to the needs of the customer and to understand the operation of the customer. Often suppliers implement and maintain customer databases and related customer management systems. The strategy work is based largely on certain medium-term (development) projects, which are completed by short-term strategic plans. The model opens up possibilities for interactive strategy planning.
3. In an *interaction model* the customer is considered as a partner co-creating value. Suppliers aim at understanding customer business and at value creating with the customer and to develop offering and solutions (often service processes) that support the customer value creation. The development work also takes place in customer

collaboration. The model emphasises knowledge management and creation, piloting, and utilising knowledge that different actors at the supplier and customer have. Also external actors are often utilised, see e.g. Chesbrough (2003) for more information of open innovations based on interaction of several actors from different organisations.

IV. Systemic and Strategic Nature of Service Innovations

Because services are processes in which the value is co-created with the customer (e.g. Grönroos 2000) they are systemic by their nature as illustrated in figure 1. The service innovations affect the service provider and the customer by changing the processes between these two. Thus, the service innovations affect the value creation, which has an effect on business logic and earning. As a consequence, service innovations are innovations, which renew the businesses of the different interest groups. When this takes place, the service innovations start to renew the markets: in future, the customers only accept e.g. product service combinations because the customers have outsourced some of the processes that they previously had - e.g. maintenance. Innovations have also been identified (Chesbrough 2003, Von Hippel 1998) that actually change the rules of the game and enable increasing value creation opportunities for different actors. These kind of innovations are often referred as strategic.

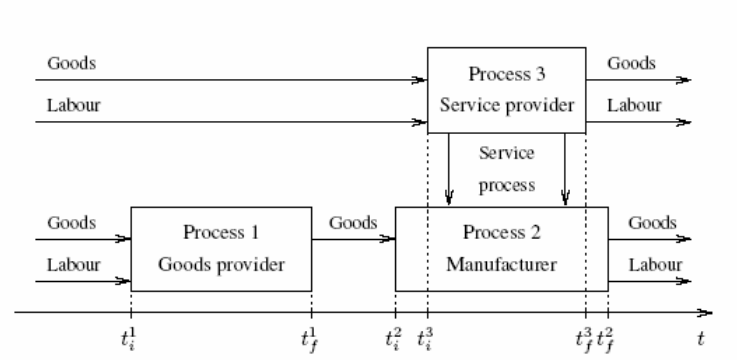

Figure 1. Industrial service process (based on Parrinello S. 2004).

A systemic innovation sets some challenges for companies (Henderson, R.M., Clark, K.B. 1990, von Hippel, E. 1994):

- They need new skills and competencies.
- Because they change linkages between components they may need new organisation structures, practices and processes from companies in order to be successfully analysed / understood.
- Their influences across business levels are often underestimated in a company.

V. A framework for Facilitating Service Business Innovation

Due to its systemic nature, service innovation needs to be addressed from the viewpoints of interest groups: the customer (and the customer's customer) needs to be involved.

Because service innovations change the processes and are the impetus for renewing organisation structures, they involve the different levels of the company. Service innovations can not mainly be conducted in any company level alone. They often require that the management is actively involved – again at both ends: at the customer and at the service provider. All this depends on the positioning of the services in the product – service continuum: if the service provider, the customer and the markets are very product centric, and there are no aims to change this status quo, then the systemic nature is lesser. In this case the service is often designed in push-mode and the emphasis is on effective in-house value chain (e.g. Pulkkinen et al. 2001). However, if one aims at moving towards a value shop approach, then either demand pull or even interaction based models are more commonly applied. In these

cases, the service provider and the customer are in practice often developing relationship based services. The implication of this kind of development is an increase in the share in which the service supplier is involved in the customer value creation.

Thus to co-create value the integrator and the customer need to develop their businesses and collaborate on different business levels. We consider this kind of service business transformation as systemic (crosses company borders on several levels). In Figure 2 we depict a framework to facilitate systemic service business innovations in a service provider - customer relationship: the elements of the model are opened at the integrator and at the customer.

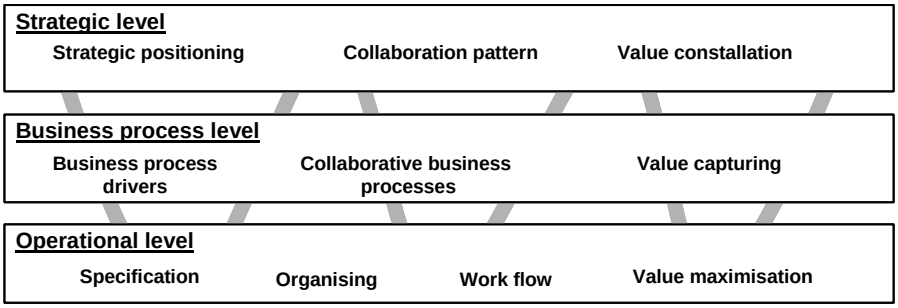

Figure 2. A framework for describing a service business innovation over the phases.

The levels described in the framework need to be addressed during the different phases of the service innovation, although different elements may take a larger importance depending on the phase. In short the phases are: analysis of opportunities; service concept, system and process development; implementation; and market introduction.

VI. Conclusions

In this paper we first defined service innovation and then we described a methodology that facilitates creation of a successful service business. The methodology has been tested in some cases. The aim is to develop the methodology further to enable also assessment of service business transformation on individual, (IT) system and work process performance. This kind of assessment would open up more views other than business viewpoints, on evaluating the successfulness of a service business that is innovative.

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Decision Points in the Innovation Process

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Abstract: The creation of a new product idea and the economic utilization defines an innovation process. The process is exemplified by the example of industrial mechanical engineering and electrical engineering. How to control an innovation process? An approved possibility is the splitting of the entire process into small and manageable parts. At the end of every step a chance risk evaluation is implemented. The innovation process consists of the three steps idea generation, innovation project and commercial exploitation. The generation of a new product idea begins with an external trend and an internal component. The internal component causes a specific product positioning within the company. A tendency cannot be influenced by an individual firm. It has to be noticed, evaluated and selected with respect to the needs of the company. Then the life cycle curve has to be estimated. The synthesis of tendency and business product strategy leads to the goals of an innovation task list for the R+D department. A well structured R+D - project follows. Finally the commercial exploitation takes place. Key figures are proposed to pursue the process steps. They consider the process in its relationships into the past and also to the future.

Keywords: Innovation process, project management, steering of innovation

I. The Innovation Process

In this article an innovation is defined as the creation of a new product idea which is successfully commercialized by an industrial company. An overview is given by Eversheim and Bullinger (Eversheim 2003, Bullinger 2006). This paper focuses on small and middle-class producing business companies of mechanical and electrical engineering.

The concept is described by Kästel (Kästel 2006). In the first phase the idea of the new product is born. There is an impact of an external and an internal component. Externally there are one or several available trends. They have to be regarded with respect to their life cycle curve. In general a company is rarely able to influence these tendencies. Tendencies express the expectations of the customers. Any business company correlates its own possibilities with these trends. Typical tools are the well known product portfolios. Trends are connected with the internal product planning. Result is a customer requirement specification. It includes the strategic planning of the company. Project management gathers the ideas in a further phase. A standard moderated R+D - project is installed. The task designation changes the actions from the strategic to the operative area. Finally the product is produced and commercially exploited.

We find a clear process structure shown in figure 1, with definite milestones, which allows to pursue the whole process in 10 steps. Every milestone permits the possibility to test the result and minimize risks.

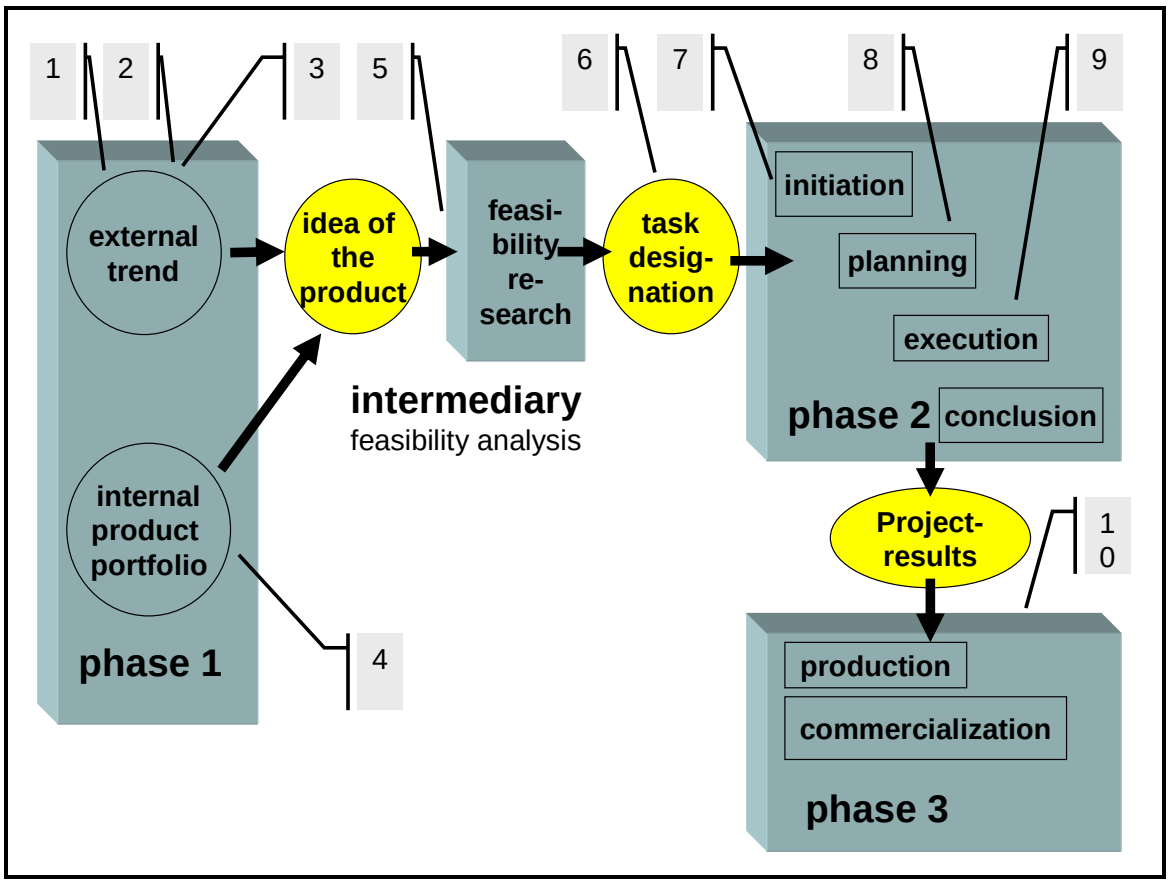

Figure 1. Phases of an innovation process

II. Ten Steps of the Innovation Process

1. First Step: Collecting Trend Information

Market tendencis had been described by J. Schumpeter (Schumpeter 1997). The idea has been adopted in this paper. Every company should select the trends for itself and prove, whether these effects have an impact on customers and product portfolio. It seems helpfully to put these trends down in a list. You can find trends on the internet, in publications and lectures of scientific conferences and in books. The industrial users will soon detect a problem. Many relevant papers only portray global trends. The entrepreneur however needs concrete help for his daily decisions. He has to invest money for R+D - projects. For the schedules of industrial product developments a period of ten years is important. The consolidation of a basis development takes 5 years, the market penetration takes another 5 years. Everything beyond this time scale is wild guess.

2. Second step: Relations of these trends to the own business field

If existing trends will have been figured out, they should be filtered in categories, which involve business affairs.

Trends should be qualified in

- primary trends: They directly deal with the existing business field.
- secondary trends: They describe additional features to equip new products.
- tertiary trends: They describe situations outside the direct influence of the business world, but however have an influence on it.

3. Third step: Quantification of the Life Curve of a Trend

The standard life cycle is a tool for representing a trend. This is usable for every kind of trends. The realization degree is shown against the time progress. Fixed points are established such as assumption, first signs, first market penetration, final market penetration, saturation of a trend. The quantification of the trend is described. It is not very important to measure events, lying far away. This description is appropriate for every kind of trend.

4. Fourth Step: Strategic Product Positioning

The combination of identified trends with the possibilities of the company delivers the product strategy. It is drawn in a portfolio. They are described by Schäppi (Schäppi 2005) as

- Boston Consulting Portfolio,
- Mac Kinsey Portfolio and
- A. d. Little Portfolio.

Actions result from norm strategies of the portfolio technology. If the company behaves itself like a pioneer it will be the first to enter the market. It could also use the follower - strategy waiting until the market is served. The market share and the features are well known. The risk seems not very big. The product prize mainly determines the market success.

5. Fifth Step: Advance Development

The product idea meanwhile is matured and supported. The state of realization begins. Before, however, a completely different issue has to be regarded.

- Does the technology assumption really exist,
- does the product work in the provided way,
- does it keep within the cost limit,
- does the new technology have an impact to the scheduled pieces of the product,
- how much has to be invested into the new technology,
- is the market receptive for the new technology,
- are the trends verified in the new technology?

These subjects have to be cleared first. To do this, an advanced development has to be launched.

6. Sixth Step: Project Tasks

The result of the advanced development is a requirement specification for a development project. It is delivered by the management to initiate the project. General goals, connected with this project are articulated. A summery is given by Kerzner (Kerzner 1997) and in a German issue by the German Projectmanagement Society (Rationalisierungskuratorium 2003). These are

- the features of the new product,
- cost of production,
- time of development,
- development expenses,
- the designated market,
- restrictions for the production,
- differentiation to the most important competitors,
- hints for production,
- certifications.

7. Seventh Step: Initiation of a Project

While the actions listed before happen mainly in management floors, another group of co-workers primarily from the R+D - department are joining the innovation process. At the end of the idea finding by the management, the project team of the operative area continues the innovation process. The methodology of project management is well established. The task designation is the junction of the strategic and the operative area. This is an important

intersection point in the whole process. The project group will be established. The prerequisite for the project execution will be given.

8. Eighth Step: Project Planning

The project is planned professionally. A work breakdown structure is established, work packages are described, milestones, network plan, communication plans, resource allocations of co-workers and costs. Finally the risk evaluation is analyzed.

9. Ninth Step: Project Execution

A project team shows a structural weakness. Normally a project leader is not disciplinarily instruction-authorized to his co-workers. He is able to make decisions especially on investment plans beyond of his project plan independently only in a very restricted framework. Since however every ambitious project can be performed only with typical corrections, there must be a mechanism to steer the project oriented to the goal. This is executed through a report and control procedure together with a management guided and adjournment authorized steering committee. A project is as colourful as life. There may appear a lot of unexpected impacts. Illnesses, breaking off of suppliers, rise of cost, behaviour of the competitor. Here the project leader has to do his job, supported by the steering committee.

10. Tenth Step: Project Conclusion and Market Introduction

Results of the project execution are drawings and appliances about the manufacture of the new product. Normally production planning and production control are integrated in the project plan. Sometimes the pilot lot, first series still are included in the project scope. Project conclusion, documentation, lessons learnt, transfer of the records of production and market introduction will follow.

III. Financial Ratios

This process is accompanied by ratios such as

- number of new developed products within the last four years,
- rate of development cost percentage of the turnover,
- ratio of qualified personnel in R+D within the whole staff,
- number of patents,
- time to market,
- part of R+D - employees ,
- R+D - products: ratio turnover to R+D cost.

Ratios and check lists can be found in the book of Disselkamp (Disselkamp 2005). In fact, the difficulty of defining ratios, is the time lag between development and the market introduction. Also ordinal or nominal scales instead of cardinal ratios have to be used. They also should be separated in parts concerning the company as a preposition for innovative actions and the innovative project.

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Avoiding emergency innovation: change prediction in innovative products

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Abstract: Bringing successful innovative products to the market is in many cases a careful balance between targeted innovation and the reuse of existing technology. Innovation introduces risk, which can be kept at a minimum by careful application of tested technology, provided designers have a clear understanding of how new technology can be incorporated into existing products or how tested technology can be brought across into new products. In reality this integration often fails, and designers need to look for innovative solutions at the last minute to integrate new and old parts. To avoid this "emergency" innovation – as it was termed by an automotive engineer – designers need to understand how different parts of a product are connected to each other and how changes to one component affect other components. This paper reports on a method to predict how change propagates through existing products. A product is represented as a square matrix and the pair wise dependencies between components are captured with likelihood and impact values, so that indirect risk can be calculated. Using various graphic representations of the structure of the product, designers can explore dependencies in the product and avoid design choices that might force them to change highly connected parts.

Keywords: Engineering Change, Innovation, Conceptual Design

I. Introduction

Innovation is vital for company to stay in the market and expand their share. Meeting new customers needs and presenting novel salutation requires a constant stream of innovations. For many companies this is a process of actively searching for new ideas which can be turned into products, but also looking for specific solutions for new opportunity. Some industry sectors, for example audio recording and reproduction, are driven by constant innovation of ever smaller, cheaper and more efficient devises. New products are developed around key innovative ideas. While the new generating of recording products carry out the same functionality and have similar user interfaces, the key technology is very different and a product with a different technology, will share few, if any of the components and manufacturing process with the pervious generation of products. These innovation steps are possible, because the products are relatively cheap and have short life cycles. Users have come to expect a new generation of radio recorder or digital camera every few years.

However innovation in very complex products, such as cars, engines or aircrafts follows a different pattern. While these products are also under pressure to improve their performance and meet new customer expectations, they are rarely, if ever, designed from scratch. Innovation has to be evolutionary to reduce risk and keep the development costs in bounds. This paper is informed by two case studies into the design of such complex products: on change in diesel engines (Jarratt et al. 2004b) and planning in sport cars (Eckert and Clarkson 2004), where 26 and 15 interviews respectively were carried, transcribed and analysed. In these industries much innovation is driven by environmental legislation, which places very stringent requirement on manufacturers at a given date, when it becomes illogical to sell products that do not comply. For example in 2011 tear 4 legislation for diesel engines becomes mandatory. While diesel engines are very mature products, which have been following the same technical principle since 150 years, radical changes will now be required. Different manufacturers are currently working of very different technological solutions to meet these requirements, however what all of them have in common is that they will try to preserve as much as possible of their tried and tested technology.

Risk drives many development processes (Browning and Eppinger 2002). Companies need to be confident that their product will be ready in time, for example to have a product to sell when

the new legislation comes, and is of sufficient quality. For complex long life products quality is not only a matter of performance, but also of reliability, which encourages companies further to keep tested components, with good reliability track records. During conceptual design, they must commit to the innovation that they want to carry out and decide with components they wish to keep. The design effort will then be directed towards developing the innovative components, and adapting existing components to incorporate the new innovation, but maintain the interfaces with existing components. In practise this can be very difficult to realise. When a component is redesigned to accommodate innovation, it is difficult to contain this innovation within the component, and frequently changes start to spread across the product. In the end components need to be modified, which are originally required to stay untouched. This is most frustrating, because it increases design cost, but also had the designers know that this component would be modified, they might have conceived the entire design differently. In the attempt to stop change from spreading across a product, designers are often forced to look for radically different solution to some of their sub-problems. This is the place where much innovation in the design of mature complex problems occurs, as emergency innovation, during detailed design to stop change from spreading across the product. To control this emergency innovation, designers need a way to assess where changes are likely to spread to, so that they can avoid them or embrace them. In the remainder of the paper, we will discuss a method to predict the risk of change and its implication for innovation planning.

II. Change Prediction Method

The CPM method as described by Clarkson et al. (2004) is centred on the computation of indirect change propagation risks between components. The basic assumption is that if one component changes, this change can have knock-on effects on connected components, meaning that there exists a probability that adjacent components change in response to the initiating component. These components can then in turn cause changes to adjacent components, so that change spreads through the system. The CPM method aims at identifying these "hidden" indirect change dependencies between components and drawing the attention of the design engineers and managers responsible towards "hidden" high-risk connections. It was shown (Jarratt 2004) that the results obtained through this method match the expectations of experienced designers and that the method was also able to predict past cases of change propagation.

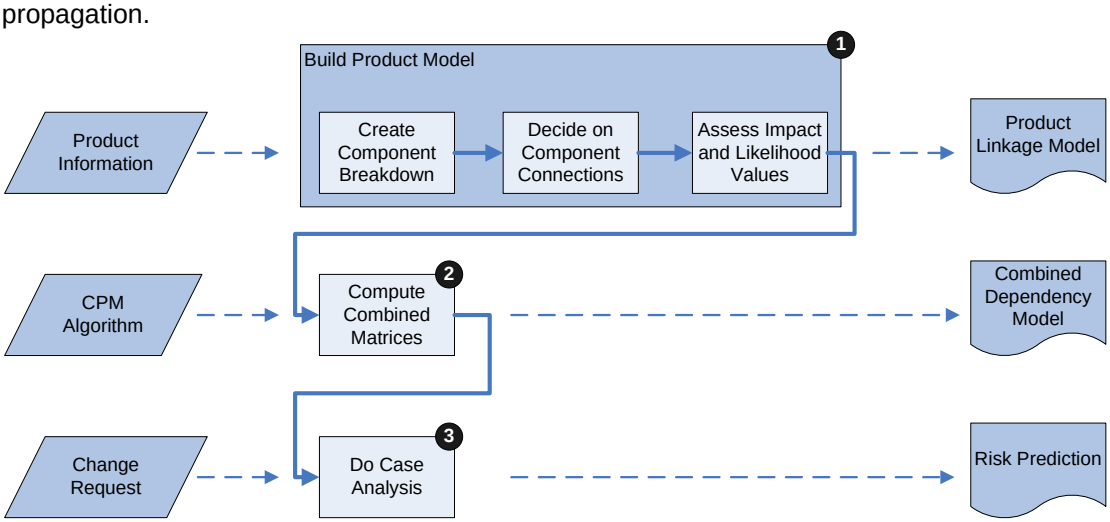

Figure 1: The Change Prediction method

Around this method, a change management methodology was developed (see Figure 1), which consists of three stages: building a product model, computing combined risks and analysing risks. The first stage involves the creation of a product linkage model (Figure 1). This model captures the components of a product and models linkages between them (Jarratt et al. 2004a). This model is then further refined to a probabilistic model that also captures the likelihood and

impact of a change propagating between each connected pair of components. This data is then used in the second stage to compute combined risk values. In the analysis stage (stage 3) this data is visualised in such a way that high-risk connections can be easily identified and acted upon.

III. A Tool for Assessing the Risk of Change

The general strategy implemented in the software is similar to that used in explorative data analysis tools that allow the user explore data (i.e. the product) in an abstract way and perform most of the analyses visually using multiple linked representations (e.g. (Gero and Reffat 2001) (Unwin 2000).The identification of future change risks from previous designs can be crucial, even in the conceptual design phase, as it helps avoiding repeating past mistakes. If, for some reasons, an unanticipated and unwanted high risk of change propagation exists between two components, then it might be beneficial to rethink the architecture of the product or be very careful when designing certain parts of the product. Direct connections are elicited from designers and expressed is a connectivity matrix or graph, a discussion which alone raises aware for the properties of the starting design. A matrix visualisation can make those hidden links explicit. The tool also enables designers to explore the multiple paths that link two components. The example in Figure 2 brings out a strong indirect link between the *Fuel Injection Assembly* and the *Wiring Harness*. An inexperienced designer might assume that changing the Fuel injection does not present any risks regarding the *Wiring Harness*.

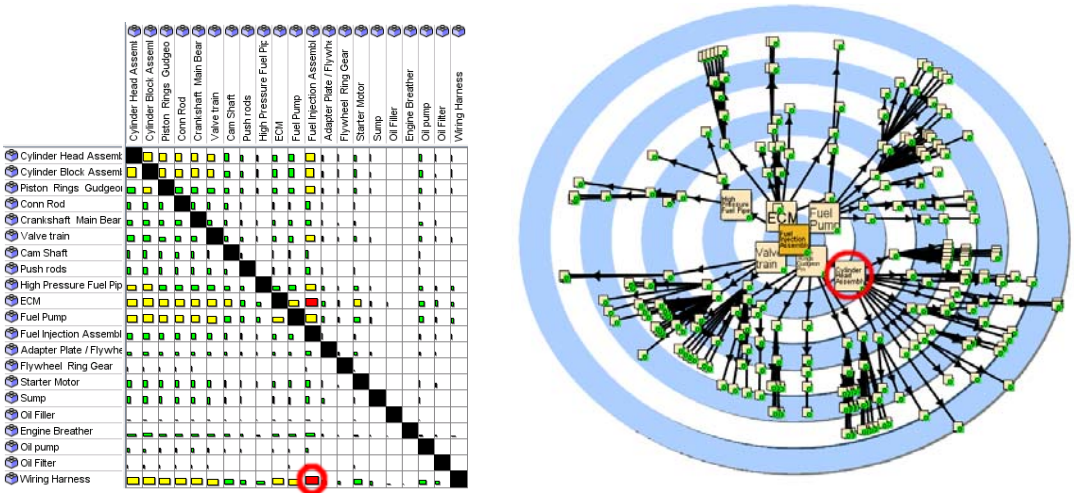

Figure 2: The combined risk plot visualises combined change risks for all component pairs

In a new design, knowing which components absorb changes and which components are potential multipliers (ref) can be very important, so that these components can be frozen from the beginning or early in the design process. The CPM method allows easy identification of propagation absorbers and multipliers. See Figure 3 for a example scatter-plot of the diesel engine. The X-axis shows the cumulated risk to other components resulting from a change to this component; the Y-axis represents the cumulated risk from incoming change. Components in the top-left box have a small effect on other components but have a high risk of being changed by changes to other components (propagation absorber). Component in the bottom-right box are propagation multipliers, i.e. components that are rarely affected by other components, but changes to them require potential redesign to a number of other components. Then there are components that have a generally low impact (bottom-left box) and components that both are affected by other components and affect other components (top-right). The latter components will require especially high attention from the designers, as their behaviour cannot be easily predicted.

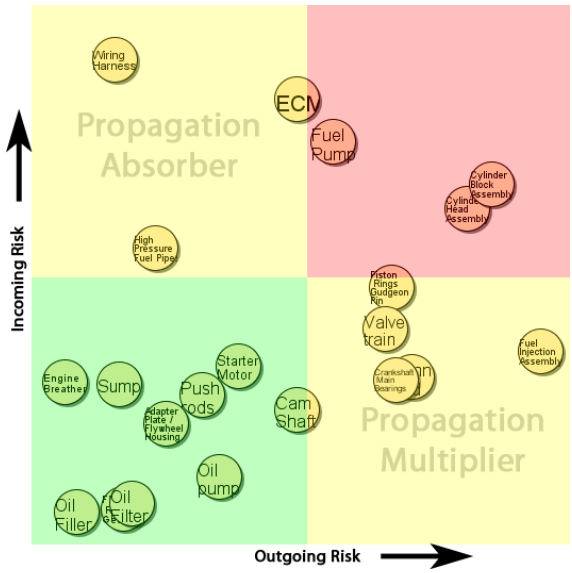

Figure 3: Component classification based on change risks

IV. Conclusions

The financial success of a project, requires planning of innovation, so that companies can direct their effort into value-added innovation, rather then emergency innovations, which require similar effort and incur similar risk, but do not contribute to improvement functionality. The CPM tool allows designers to explore the way changes spread through a product, so that they can assess which components they want to freeze and which can absorb changes without upsetting the design process too much.

Acknowledgements

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A Knowledge Management Approach to Support Learning and Education of Newcomers in Wide Organizations

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Abstract: Knowledge Management has been always considered as a problem of acquiring, representing and using information and knowledge about problem solving methods. Anyway, the complexity reached by organizations over the last years has deeply changed the role of Knowledge Management. Today, it is not possible to take care of knowledge involved in decision making processes without taking care of social context where it is produced. This point has direct implications on learning processes and education of newcomers: a decision making process to solve a problem is composed by not only a sequence of actions (i.e. the know-how aspect of knowledge), but also a number of social interconnections between people involved in their implementation (i.e. the social nature of knowledge). Thus, Knowledge Management should provide organizations with new tools to consider both these aspects in the development of systems to support newcomers in their learning process about their new jobs. This paper investigates how this is possible through the integration of storytelling and case-based reasoning methodologies. The result is a conceptual and computational framework that can be profitably exploited to build effective computational systems for the training of newcomers in wide organizations, according to a learning by doing strategy.

Keywords: Learning by Doing, Storytelling, Case Based Reasoning

I. Introduction

Storytelling is a short narration through which an individual describes an experience on a specific theme. In this way, the human being is motivated to focus the attention on his/her own knowledge about the specific theme that is the subject of narration (Bruner, 1991). Within organizations, storytelling can be considered an effective way to treasure the knowledge that is produced from the daily working activities. For example, Roth and Kleiner (1997) have analyzed how the adoption of storytelling allows an organization to be more conscious about its overall knowledge, to share knowledge among all the people involved in its generation, to treasure and disseminate new knowledge originated by the sharing of different stories. The adoption of storytelling can promote the development of new professional contexts where different professionals collaborate to solve common problems, share experiences, explicit and implicit assumptions and understandings in order to improve the global capability of the organization to transform, create and distribute knowledge. In this sense, Knowledge Management can profitably exploit the storytelling as a way to make explicit the individual experiences, skills and competencies, promote the negotiation processes through dialogues among people involved, support the reification of new knowledge in order to make it available for the future and help newcomers in the learning process about his/her job through the analysis of the problem–solving strategies and social context represented by the stories. In this paper, we present a conceptual and computational framework for supporting continuous training within wide organizations, in the learning by doing (Wenger, 1998) context. This approach (Bandini and Sartori, 2005) is based on the integration of storytelling and case–based reasoning (Kolodner, 1993) methodologies: the former allows to manage a decision making process like a story that describes problem characteristics and what kind of communications among people and problem solution strategies can be applied to solve it; the latter is a very useful and efficient mean to compare stories (i.e. cases) finding solutions to new problems by reusing past experiences. Moreover, an application of the framework to the SMMART project will be briefly introduced.

II. Learning by Doing, Storytelling and Case Based Reasoning

Learning by Doing is based on well known psycho-pedagogical theories, like cognitivism and behaviorism, which are devoted to point out the role of practice in humans' intellectual growth and knowledge improvement. In particular, this kind of learning methodology refuses the typical idea that concepts are more fundamental than experience and, consequently, that only a solid set of theoretical notions allows to accomplish a given task in a complete and correct way. Learning by doing methodology states that the learning process is the result of a continuous interaction between theory and practice, between experimental periods and theoretical elaboration moments. Learning by doing can be articulated into four distinct steps (Figure 1), where practical phases (i.e. *Concrete Experience* and *Experimentation*) are alternated with theoretical ones (i.e. *Observation and Reflection* and *Creation of Abstract Concepts*): starting from some kind of experience, this experience originates a mind activity that aims to understand the phenomenon; this step ends when a relation between the experience and its results (typically a cause-effect relation) is discovered that can be generalized to a category of experiences similar to the observed phenomenon. The result is a learned lesson that is applicable to new situations which will eventually occur in the future.

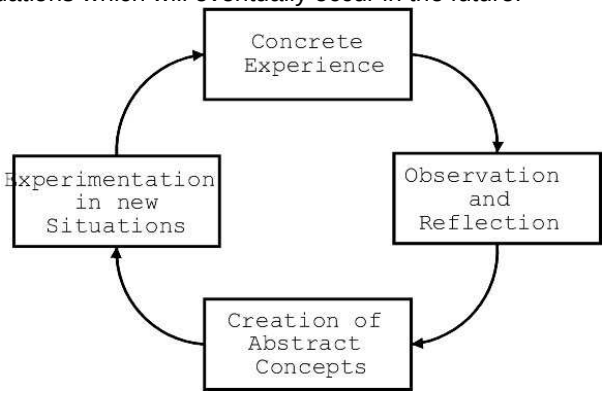

Figure 1: the four steps in learning by doing

In our framework, a *concrete experience* can be represented by a story, that represents a decision making process about a problem to be solved. This story should give to a newcomer an idea of how a critical situation could be tackled, according to the knowledge owned by experts. Moreover, it could give indications about who could help him/her in case of need.

Stories can be archived as cases according to the case-based reasoning (CBR) paradigm. A case is a complete representation of a complex problem and it is generally made of three components: *description*, *solution* and *outcome* (Aamodt and Plaza, 1994). The main aim of CBR is find solutions to new problems through the comparison of it with similar problems solved in the past: the comparison is made according to a retrieval algorithm working on problem features specified in the *description* component. When an old problem similar to the current one is found, its solution is reused as a solving method for the new problem. Finally, the outcome component gives an evaluation about the effectiveness of the proposed solution in solving the problem. In this way, new cases (i.e. stories) can be continuously created and stored to be used in the future, building up a memory of all experiences that can be used as newcomer training tool.

Starting from concrete experiences newcomers can learn decision making processes adopted within the organization they are introducing quicker than studying manuals or attending courses. Moreover, the comparison between his/her own problem solving strategy and the organization one represented by stories stimulates the generalization of problems and consequently the reflection about general problem solving methods, possibly reducing the time period to make the newcomer able to find effective solutions.

III. A Case Study: the SMMART Project

SMMART (System for Mobile Maintenance Accessible in Real Time) is a research project funded by the European Community, that aims to develop a decision support system for supporting experts of Volvo Truck and Turbomeca, a world leader in the production of helicopter engines, in troubleshooting engine problems. To this aim, a case-based reasoning module of the final system is going to be designed and implemented in order to detect the most probable faulting engine component on the basis of a given set of information, which can be archived as a story. In what follows, due to the lack of space, we'll consider only the truck troubleshooting problem, but a similar approach could be used to describe helicopters' one too.

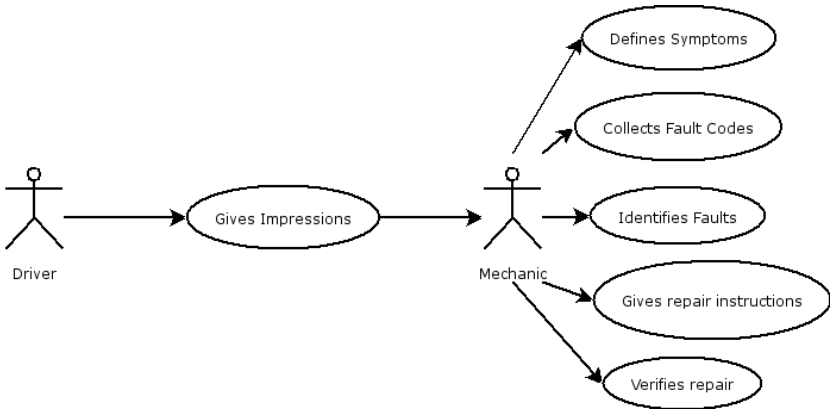

Figure 2: The story about a truck troubleshooting session

The narration (see Figure 2) about the problem starts when a driver recognizes in some way that a problem arose on his/her truck. For example, a light of the control panel turns on or some unpredictable event happens (e.g. smoke from the engine, oil loss, noises during a break and so on). Thus, the driver contacts the truck after sale assistance to obtain problem solution. The mechanic who receives the truck) is responsible for making a detailed analysis of the truck by taking care of driver impressions, testing it and collecting information coming from on-board computers. Then, he/she has to find the fault, repair it and verify that the problem has been solved before the truck leaves the workshop.

The problem analysis made by mechanic considers two main categories of information: *symptoms* and *fault codes*. Symptoms give qualitative descriptions of truck problems and their context. For example, the sentence *"The truck cruise control fails to maintain set speed while driving uphill at -20℃ under heavy charge"* specifies that a possible fault of the cruise control (i.e. the symptom) is detected when the road is not plane, the temperature is very low, and the truck is transporting a big load (i.e. the context). The same problem could be not detected under different conditions. Fault codes are quantitative information coming from on-board computer: when some event happens that possibly causes malfunctions, a fault code is generated and memorized to be used during troubleshooting sessions. A fault code is characterized by many fields, the more important of which is the FMI (Failure Mode Identifier) that identifies the category of the fault (electrical, mechanical, and so on). The main activity of the mechanic during the truck analysis is the correlation between symptoms and their fault codes: in this way, it is possible to identify the faulty component, repair it and try to verify if problem has been solved by controlling if fault codes disappear when the truck is turned on.

The CBR module of the SMMART project has been designed to give suggestions about the most probable faulty components of the truck engine according to a given combination of symptoms and fault codes. To this aim, a story about a troubleshooting session is represented as a case, made of two parts:

- Case description, containing all the information necessary to characterize the truck problem, that is symptoms, fault codes, symptoms' context and general information about the truck (e.g. the truck model, the type of on-board computer, and so on);

- Case solution, containing the more probable faulty components of the truck according to the given problem description. This component could be a *root cause,* that is the real and atomic source of the fault that should be substituted (e.g. an electric cable) of something more general that should be further investigated in order to find the root cause (e.g. the cooling fan). In the second case, the solution gives indication about the most useful troubleshooting method too (typically, fault trees or MBR is used).

When a new story is generated that represents the current problem (i.e. a problem without solution), it is represented as a case and properly described in terms of symptoms, fault codes and context. Then, it is compared with other cases already solved in the past in order to find similar story descriptions: The solution of most similar story is then reused as a starting point for deriving the solution to the current problem, suggesting in this way the most probable root cause or the best method to identify it.

From the learning by doing point of view, the case base composed of all the stories about past troubleshooting sessions is a very important source of knowledge for newcomers: they could be solicited to solve a problem by specifying what are the symptoms and the related fault codes. Then they could try to identify faulty components and then compare their solution with the one proposed by the system, with an immediate evaluation of their own capability to learn expert mechanics' decision making processes and identification of points they have to work on, maybe asking directly to the people who solved past problems. In this way, experience and knowledge created by the organization over the years and captured by the CBR system could be used as a very important training methods alternative to the more traditional ones.

IV. Conclusions

This paper has presented a discussion on how the problem of supporting learning by doing within wide organizations can be tackled exploiting computer-based approaches.

The proposed framework provides newcomers with a complete representation of the competences developed by experts over the years. Thus, they can increase their experience about the problem solving strategy used inside the organization as well as the understanding about who are the people to contact in case of need (i.e. the experts who solved similar problem in the past).

In order to test the effectiveness of our approach, its application in the context of the SMMART project has been briefly introduced. Future works are devoted to verify the applicability of the proposed methodology in building supporting systems for learning by doing in other complex contexts.

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From management of innovation to management by innovation? A question to small and medium companies.

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Abstract: This paper aims to discuss management of innovation in small and medium-sized enterprises (SMEs). Indeed, it is a great challenge to transform these very often traditional companies into technological leaders on their markets. According to various collaboration with SMEs on several topics and discussions with people from interfaces agencies working with this kind of companies, several questions arise. Our aim in this paper is then to tackle these questions and to lead a reflection on the meaning of management of innovation in SMEs. This led us to wonder about their reason for being. We conclude that small and medium-sized enterprises are complementary to big companies, but they are totally different. Thus we can't manage them in the same way, and especially we can't deal with innovation in SMEs in the same manner we do for big companies. That is why we propose to see innovation as a resource to create new companies, but also as a resource to perpetuate existing SMEs. This conducts us to defend the idea of a "management by innovation system" as an alternative way to manage small and medium enterprises.

Keywords: Innovative organisation, SME, Management of changes, Problem solving, Management of innovation

I. Introductive remarks

In the context of today's industrial organisation, collaboration between big and small and medium companies becomes more and more emblematic. Especially because more than 90 % of companies in Europe and in a lot of other countries are small and medium-sized enterprises. SMEs need to do so as well as big companies. It seems to be the rule. But how is it possible to be sure that the rule is the same for big and small companies? We propose to go answer this question with the means of innovation management.

Faced with high speed changes and an increase in of all kind of complexities, big companies have today a great challenge: to innovate. But why is it a challenge, whereas numbers of companies are already innovative? And why do small and medium companies have to take up this challenge? Is it also a challenge for them? If yes, is the challenge formulated in the same terms? Can it be taken care of with the same solutions?

One important question is to be able to characterise the need of small companies according to this question of innovation. Is it possible to define a general goal, and then to built a general answer to this question? The more frequent answer is no: characteristics of SMEs are so different that it is difficult to give a general representation of their evolution according to their very different goals.

Despite this, we heard everywhere that it is important to increase innovation of small and medium companies. But according to what has been said previously, it seems to have no sense: how is it possible to help a group of heterogeneous companies to reach such a generic goal? What does "increase innovation" mean for this kind of companies, especially if a great deal of them is currently non innovative?

II. Disadvantages of big companies vs SMEs

When we speak about innovation, we speak about a lot of different things. There is no chance that the topic we have to treat is the same for all small companies. We propose a first step in this paper. Our aim is to characterise why companies and especially the ones with a small numbers of employees begin to integrate changes, and especially inventive ones, in their organisations, or at least in their products.

The first question we want to ask is: why do we need to push small and medium companies to make changes and to be able to manage changes. According to the concepts of economies of scale and economies of scope, it seems to be more interesting and more profitable to develop big companies. To answer this question, we propose to describe the disadvantages of big companies and to describe the comparing advantages of SMEs.

So, several answers can be formulated to this question.

1. Cost of the structure

First of all, big companies are faced with an increasing cost of their structure. Indeed, to develop several units through the world, organise them in such a way as to be efficient requires on the one hand to rationalize the work and the functional organisation (for example with a few number of specialised team in R&D distributed among the world or at least among a large geographic area), and on the other hand to develop the coordination between the units. This need of coordination can cost a lot because of at least three distinctive dimensions. The first one, which is well known, is linked with the functional differentiation; it is needed to coordinate Marketing and R&D for example. The second one is linked with the number of specialised units and their geographical distribution; it is needed to coordinate R&D team on engine block in France with the R&D team on brake in England for example. The third one, which exacerbates the two first ones, is the different languages used in the different teams, and their associated cultural effects; how to be sure that the French and the English teams are able to communicate, to work together, do they use the same tools, the same method of working … In response to this coordination problem, big companies set up processes. But it takes times and money. Moreover, it rigidifies companies because there are unavoidable committees, needed for commitment, flashes back, increase of time, of money … According to this formalised coordination, big companies become more and more bureaucratic.

So coordination in big companies has a major cost, which doesn't exist in such a form in small ones. Coordination is more based on personal relationships and more informal commitments.

2. Lack of flexibility

Costs of the structure and unavoidable need for coordination induce lack of flexibility in big companies. This lack of flexibility drives the company to a lack of reactivity. Indeed, big companies are not so reactive to the occurrence of internal or external shocks.

Small companies have the capability to catch more quickly information. But there is still a question: do they have the knowledge and the skills to integrate it? We will approach this question in paragraph 3.1.

3. Labour cost

In big companies, the labour cost is a big part of the global costs. Then, they are more sensitive to the evolution of this cost and then to the globalisation. To relocate some of the units, especially in low labour cost countries, can decrease dramatically their costs.

When the labour cost has a lower weight in the global costs of a company, it becomes less interesting to relocate activities. So to develop and to be sure that SMEs can survive in a given geographic area could be a way to protect local employment.

4. Distance with customers

According to the necessity to have an international structure, big companies are often obliged to localise some of their units (R&D teams or production units for example) far from the customers. So it increases delay in the introduction of coming-from-customers information to R&D activities according to re-design of products, evolution of production process or design of totally new products. Moreover, it can create misunderstanding between needs or wishes of customers and useful information for design activities.

SMEs are closer to their customers. They can be more reactive and they have ability to develop relations through building networks with other companies.

So we describe briefly some of the advantages of SMES vs big companies. It is clear that these advantages can also be seen as disadvantages if your aim is to explain why an economy needs big companies. In fact, for the same reasons we need a global industrial organisation based at the same time on big and small companies. Because the two opposite characteristics (centralised and decentralised teams, reactivity and bureaucracy …) are needed to be sure that customers can be satisfied in quality, in quantity and in price wishes.

In this paper, we would like to focus on the necessity to develop the industrial network of SMEs at a local level. One of our major conclusions is that we have to develop small nearness companies in two directions: it is needed to encourage the creation of new companies and it is needed to perpetuate existing small companies. It is then necessary to link these two directions with the will of local public institutions to develop innovation in such companies.

Our point of view according to this is that innovation (even if we have to define clearly what it means) can be a resource for this or a more efficient way to manage the company .That is what we will present in the next part.

III. Management by innovation

Our purpose in this article is to defend the idea that innovations can't be considered as a final goal but more as a way to help company to succeed. In fact, instead of managing their innovation, a lot of companies want innovation to guide them in their management processes: they want to transform a "management of innovation system" to a "management by innovation system". But SMEs don't know clearly what shape the "management system" can take.

In the two next paragraphs, we propose a way to use innovation to reach the goals we identified previously: perpetuate and create small companies.

But before that: it is needed to explain more precisely what we mean by "innovation". From a general point of view, innovation is considered as the introduction of novelty in something (product, process, organisation …) which is then adopted by users. But there is an important question linked to the novelty: it is the level of novelty. We can answer this question by the distinction between breakthrough and incremental innovation. But it doesn't fit with the need to manage SMEs in a complex environment. That is why we propose innovation as a way to deal with all kind of problems small companies have to face with. So innovation can be considered as a process to identify and to formulate problems the company has to solve. In this way of thinking innovation becomes more a way to manage a company than a resource or a process to lead to a new product or to a new process.

Considering innovation this way, we can look at the two reasons why an economy needs to develop small companies.

1. Innovation as a way to perpetuate SMEs

Innovation becomes today one of the most important way to elaborate and to implement cost and/or differentiation strategies and to build and sustain competitive advantages. SMEs are in the same situation. They hope that innovation will solve most of their problems. But in order to be "management by innovation oriented", companies have to change significantly their management processes. Indeed, they have to better synchronize their different functions, to solve the right problem at the right (hierarchical) level, to be sure that each sub-(hierarchical) level is able to manage its own problems derived from the decisions of the upper levels and to succeed in solving them, and to be able to forecast most of the future problems.

But SMEs have a big handicap: most of the small organisations don't really have strategic management processes. They are more focused on current problems. They often don't have time to deal with the future. So innovation can be seen as a resource or as a way to solve problems only if small companies are able to change their way of working. Every kind of evolution needs time. Nothing can be done in few days. So small companies have to be able to

introduce characteristics of what will be the future to help them to define what to work on today, with which goals and which way to take. But this can't be done without strategic management. So the very first element which has to be checked in small companies is that they really have a strategic management. It is unavoidable.

Furthermore, as we have seen in the paragraph 2, small and medium companies have a lot of advantages. But they have to be able to use them to really create competitive advantages. And they are faced with a major disadvantage: a lack of resources. In fact, small companies don't sometimes have time to develop the needed knowledge or competences: they don't have specific R&D resources or specific resources to deal with problems, really formulate and solve them. Even if they are very close to the market, and they are able to catch a lot of interesting and strategic information, they are faced with two difficulties. They have sometimes a lack of knowledge, of competence, of strategy or simply a lack of time to integrate them in their decision processes. If they have technical competences, they sometimes don't have the capability or the network to identify what are the new knowledge and/or the new competences they need. In this context, companies need not only technical innovation but also other kind of innovation, and especially organisational innovation, to be able to grab interesting knowledge and competences wherever they are.

That is why we defend the idea that better than "managing innovation", SMEs need really to be "management-by-innovation oriented".

2. Innovation as a way to create new companies

The rate of creation of new companies is very important. At the same time, the rate of death is also important. What is sure is that this rate of death is less important when the new company comes from a new idea and is able to develop innovative activities or innovative products. The purpose here is that the entrepreneur is in position to develop competitive projects. That means that he is an inventor, but that he is also a businessman.

What we describe here could be considered as very close to the previous situation. This kind of company is in another stage of its lifecycle, the development stage. The company we described in previous paragraph is more in shakeout or in maturity stage, looking for a new idea or at least something which will boost the company. So new companies face with the same questions about knowledge management, about increasing competences, about networks … The entrepreneur faces also a management problem. An important difference is that he is more or less alone, and he has to build everything, and especially the strategy, based on his current knowledge and skills, to be able to launch his company.

IV. Conclusive remarks

As seen before, most of the SMEs want to transform their more or less "innovation by chance system" which is risky to a more "systematic innovation system". That is why we propose to see innovation as a resource to create new companies, but also as a resource to perpetuate existing SMEs. This conducts us to defend the idea of a "management by innovation system" as an alternative way to manage small and medium enterprises. This kind of system can allow small and medium-sized enterprises to generate new knowledge about solving problems, managing changes and then introducing innovation in their organisation.

NEW USES OF INFORMATION FOR IMPROVING THE MANAGEMENT OF THE FRENCH HEALTHCARE SYSTEM

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France's law of March 2002 concerning the quality of health system and the August 2004 law on health insurance reform have both highlighted the need to improve the management of the French health care system through better use of information.
Firstly we'll analyse the main tools of change: Electronic Health Record (EHR), or *Dossier Médical Personnel* (DMP) to ensure traceability (i.e. patient history) and quality of treatment, tariffs according to the activity exercised (T2A or *Tarification à l'Activité*) for a better allocation of resources, policies of certification and contractualisation for establishments and also for the evaluation of the health professionals' practices at the individual and collective levels. We'll point out the opportunities, limits and risks entailed by the solutions in use, with a special focus on interoperability and coordination (regional information systems ?).
Secondly we 'll insist on the importance of a global and coordinated approach (complexity), with the development of intermediation structures such as Health Networks (*réseaux de santé*) at the interface between hospitals and city-based medicine (primary care), two worlds that need to function less independently. We'll highlight the need to develop a culture of data quality, information sharing and evaluation.
In a constructivist approach, we use qualitative methods—including interviews with doctors, hospital staff, ministerial and healthcare officers, as well as analyses of documents— to outline the different perceptions of actors that need to be reconciled.

Evaluating organisational readiness for change implementation through a potential change maturity model

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The presented model which is developed in a European project provides a framework allowing project management teams to assess the organisational maturity to integrate new practices under structural or technological change. Maturity for change is defined here as workforce capability to operate effectively in transformed processes. In other words this methodology is addressed to tackle organisational readiness to fulfil business objectives through technological and structural improvements. The tool integrates a set of evaluations structured in three main steps defined as maturity levels. The first level "Change Impact Mapping" is the step where departments, organisational actors and the relevant impacted core competencies are identified. The second level "As Is & To Be State Comparison" introduces evaluations characterising variables such as Cooperation, Coordination and Information form. These assessments allow capturing to which extent current work practices will evolve. The third level "Transformation Costs" provides an evaluation of the needed resources and support to simulate and introduce new work process. The innovative feature of this model is to integrate technical and human capability for organisational development. Few researches have been done both considering human /technological dimensions and activity performance. This paper does not answer to all organisational change problematic; nevertheless it brings a practical resource in process design.

Key words: Organisational maturity, Technological change, Workforce capability, Activity performance, Process design

Introduction

During the diagnosis phase of an organisational change, operating structures are analysed to evaluate the impact of change on staff and departments. When the concerned services are spotted, the changing processes and activities related to organisational roles and functions are defined. Our investigations begin at this level. We define with methods such as the cooperation evaluation scale and information transformation level, the needed knowledge, skills and coactions to fulfil a transformed activity. Our aim is to capture the extent to which current work practices are evolving and to define the prerequisite skills, knowledge, practices and tools to ensure compliance with corporate procedures and process. Readiness for change which is the organisation maturity to integrate new practices is evaluated through the potential change maturity model. We access the organisational capability to incorporate new business processes and mastering there possible evolutions.

1. The European Project SMMART

This model is being developed within an integrated European project entitled SMMART (System for Mobile Maintenance Accessible in real Time) regrouping industrial stakeholders form Aerospace, road and maritime transport. This consortium launched in November 2005 for a 3 year period is constituted of 24 industrials and research centres working on the development of RFID embedded system. The project, submitted under the Framework Programme 6 received contribution from the European Community. The aim of the project is to provide new technology smart tags capable of operating and communicating wirelessly in harsh environment of a vehicle's propulsion unit. This system will enable the monitoring of usage and maintenance data trough the life-cycle of critical parts and provide secure end to end visibility of the logistics supply chain. The project also aims to establish normative referential in terms of organisation, procedures and tools involving MRO (Maintenance Repair & Overhaul) stakeholders from manufacturers to operators, various regulation bodies and insurance companies. This should improve quality and traceability of maintenance operations, and finally safety of vehicles operation. The SMMART consortium incentives are meant to enhance European leadership in the worldwide MRO sector. Investing in such research and development activities compose a strategic stake for the transport industry. According to MRO professionals, the worldwide commercial jet transport MRO market for exemple is expected to grow at a pace approaching 5 percent annually over the next five years. The issue is to decrease maintenance time in order to

maximise time in the air. The adoption of new tools will transform the maintenance activity and the relationship among MRO stakeholders. Business process changes are expected and the corresponding support tool being prepared as through the developed potential change maturity model to ensure the operational capability of the SMMART technology.

2. Capability Maturity models (CMM)

The term capability applied to organisations refers to the skills within a business structure that are relevant to managing a planned activity. The most suitable literal meaning taken from Oxford advance learners' dictionary 2004 for the term maturity is "fully grow or developed, having achieved one's full potential". We understand Capability Maturity Models as a method which allows a certain level of performance achievement prediction. One of the well known groups of Capability maturity model has been developed by the SEI (Software Engineering Institute) of the Carnegie-Mellon University. Theses models derive from Watts Humphreys original works, who introduced in the 1980's a model to improve software process development. Referring to CMMI Product Team 2002 definition, maturity is perceived as "the extent to which an organisation has explicitly and consistently deployed processes that are documented, managed, controlled and continually improved". There is a close relationship between capability and maturity they are both link to the quality improvement concept. Process maturity was born in the total quality management movement, where the application of statistical process control (SPC) techniques showed that improving the maturity of any technical process leads to two things: a reduction in the variability inherent in the process, and an improvement in the mean of performance of the process related to the capability W.Edwards Deming (1986). Thus quality improvement consists in making process stable and enabling statistical control so as to maximise capability. A process can be said to be mature as it pass trough the stage from unstable to stable and then enjoying improved capability Cooke-Davies (2004). The CMM's that are available today cover project management processes, technical delivery processes for products and software development and organisational maturity. Among theses applications of CMM our objective is to inquire about change management capability and maturity. Change management is commonly incorporated in project management and generally defined as being a constant in project based organisations. Our main objective is to describe through a change management perspective how to determine the prerequisites to acquire a capability to incorporate a designed change. Considering change management within its theoretical or experimental literature, we observe few investigations on the readiness for change Lillian T. Eby et al. (2000). It is meant about readiness the extent to which an organisation is capable to incorporate new business process and mastering them. The aim of the tool is to measure to which extent activity is going to be transformed. Structural and technological transformation due to process change can occur on different organisation levels. Skills, knowledge and practices have to de readapted to react to the constant change. To resume introducing new technical process implies the consolidation of two factors. The former is ensuring the technical capacity to support the process and the latter is ensuring the capability of the impacted unit or profession to deliver a constant process. Mastering the potential change maturity is critical to accesses the organisational ability to monitor the service levels and ensure compliance with newly design corporate procedures and processes.

3. Potential change maturity model

The model organised in 3 levels is designed to access the potential change and the organisational readiness to theses change. It is a practical tool to determine the prerequisites for processing from current state to an improve level of organisational state. Through each level a specific component of change is tackled by a set of assessments. Level 1 is the initial stage where the focus is the Change Impact Mapping on system level and on team and individual level. At this stage the As-Is organisational state is captured through interviews and the impacts of programmed change on processes and organisational structure is determined. Level 2 integrates 3 models evaluating the transformation of, information, collaboration and coordination between the As-Is state and the To-Be state. At this stage a consolidated picture of the programmed change impacts (TO-Be state) on the As-Is activity structure can be defined. The level 3 consist in measuring the necessary technical and human resources to transform an As-Is operating scheme. By the means of simulations and incremental adjustments the necessary efforts to improve the ongoing activity can be set. Theses 3 steps allow to diagnose the organisational variables that will evolve, the extent to which they will change and the organisational capacity to successfully introduce those transformations. The figure 1 describes our methodology to systematise potential change identification and change capability

evaluation.

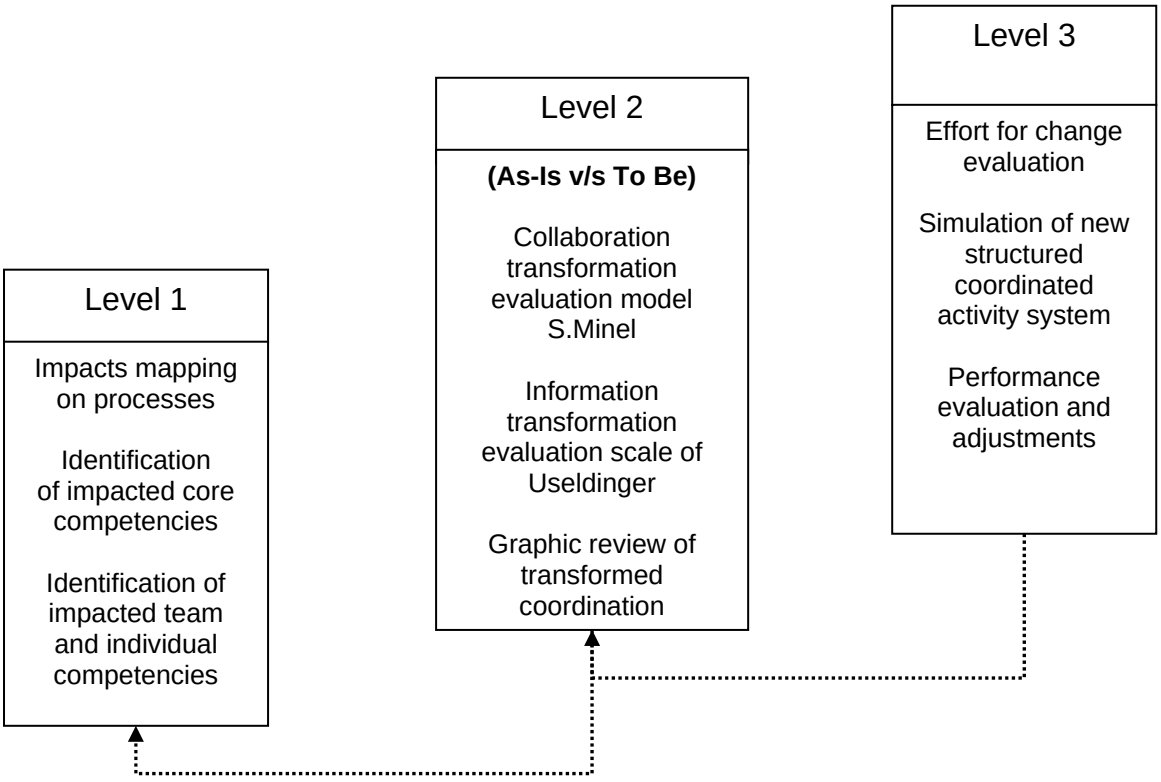

Figure 1 Potential change capability maturity model (O.Zephir 2006)

3.1 Impact Mapping

It is the first step where the impacts of the programmed change is characterised on the organisational activity. Through interviews the impacted processes and core competencies are determined. Core competencies as defined by Hammel et al (1990) are those capabilities that are critical to a business, it embodies an organisation's collective learning, the know how of coordinating diverse production skills and integrating multiple technologies. When the impacted core competencies are revealed, the link can be made to identify the teams and the individual competencies impacted. This step is crucial to fix the As Is state, it fixes the body of organisational knowledge and competencies that is concern by the change. The impacted process analysis reveals the related capability that is supported by the knowledge, skills and abilities employed by organisational actors to achieve the process goals and objectives. This level allows identifying "who" the organisational roles and functions and "what" competencies or tools, impacted.

3.2 As-Is v/s To-Be

When the As-Is situation is set the To-Be one is designed considering all the impacted stakeholders in the various concerned processes. The Minel's (2003) Cooperative Evaluation Scale (CES) is applied to characterise the level of collaboration between 2 professions involved in a same activity. Useldinger's (2002) model defining as a six point Likert scale different levels of information is readapted to express the level of information change in an activity. Our investigation consists in the mapping of collaborating professions in the spotted impacted activities. We first carry an "As-Is" collaboration situation, to evaluate the level of cooperation before the change. Characterising the degree of cooperation allows defining targets related to change implementation. That is, when considering 2 professional corps collaborating, to determine if the same cooperative level is to be kept after change implementation or if it needs to be optimised. The Minel's (2003) CES considers 6 levels of collaboration, described by the level of knowledge shared by two interacting actors. The levels are as follows: 0 stands for no knowledge shared, 1 for common vocabulary, 2. Knowledge of concepts, 3. Knowledge of methods, 4. Master of domain, and 5 for expert of domain. Empirical studies show that

in order to attain collaboration between two different professions, the level 3 of the CES is required to share a common vision of how to integrate the constrains of the other in ones own goals. Above this level, actors' specialised skills affect the cooperation. Under this level, cooperation is not efficient and can be improved. When the result of the "As Is" cooperation state is figured out, it has to be linked to the evaluation of the information changing state. This is carried out by using Useldinger's (2002) model where six level of information are defined as follows: Signal, data, information, knowledge, Skills and know-how. The model is similar to a 6 point Likert scale characterising (under a hierarchy) the different levels of information throughout different formalized schemes. The collaborating actors have to define in common the level of information changing in their activities. Defining that, allows evaluating to what extent the activity is changing, from the form of data or structure to competencies and know-how. Having those information collaborating actors are able to redefine their common activities, and also to state the needed resources, effort and support they need to collaborate under a new operating scheme. A similar evaluation is applied to evaluate coordination evolution from the As-Is to the To-Be situation there is no particular method applied here, but and indication on each described collaboration activity.

3.3 Effort for change evaluation

This last step is design to indicate for each transformed activity spotted in the level two, the necessary human and technical resources to deliver a constant process. Once the extent to which activity is being transformed is fixed, as referred in CMM models, simulations are programmed to evaluate the needed documentation, management and control to reach continuous process improvement through readjustments. The prerequisite skills, knowledge, practices and tools to ensure compliance with the corporate procedures and process are fixed at this level. We estimate that readiness for change is reached when technical and human capability is estimated in relation to a define service level with improvement possibilities. Readiness means here the organisational capacity to incorporate new business processes and mastering there possible evolution.

Referring to ADESI Specific Action (2004) we consider that the ability to answer to actual industrial stakes such as constant change, an integration of methods considering both human and technological dimensions is crucial.

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Tales from the battlefield: Three case studies of innovative virtual management structures

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Abstract: Since virtual management is a relatively new organisational form, little research has been done on structure, performance, managerial practices… This paper provides insights of three experiences of MCC virtual teams, detailing their different organisational structures, their dynamics to achieve higher performance, and suggesting practices towards common drivers for virtual management.

FAGOR ELECTRODOMESTICOS S. Coop. is one example: "Want to work with the best, but they aren't usually nearby". Since 2001, Rubén participates in virtual teams contributing to forge a new organisational model. Conceptually, teams have Spherical structure: "Similar to movie industry: Director, actors… get-together, work jointly and then part to other projects."…

MAIER S. Coop. has five production plants. "First virtual teams were born spontaneously to connect diverse national and international plants arousing from the need to coordinate people". Conceptually teams have Spiral structure "Characterised by being made-up of members who cyclically go-in, do their job, and leave in order to successfully carry-out projects"…

MCC GRAPHICS S. Coop. isn't a typical case: "It isn't a reactive response to reality but a conscious gamble on management brought by virtuality". Conceptually the structure compares to an atom: the nucleus are the joint productive structure of the companies, and around, virtual teams (neutrons) orbit providing services to this productive structure.

Keywords: fieldwork; virtual; teamwork; management; innovation

1. Introduction

"Surfing papers, folders and electronic devices, travelling miles with nothing more than the click of a mouse and a tiny web-cam presiding over his desk, and chatting with Ian: 'How do you fancy this idea ... I like it a lot... could you develop this part further while I check with Karl how things are going with the offshore team... and later we'll all meet on the Chat platform at 14:00 GPM and discuss the next steps".

This *'modus operandi'*, which we may think is far ahead of everyday practice and reserved solely for top executives spread out across the four corners of the globe, in charge of technological mega platforms, is nevertheless becoming an increasingly regular picture in all companies. Due to such factors as the internationalisation of business, the externalization of non-core activities, and the inclusion of suppliers and customers in projects, companies need to get together and redesign their creative processes so as to actively take part in the age of globalisation.

This is the case of MCC – the Mondragón Cooperative Corporation, the largest cooperative conglomerate in the world, founded at Mondragón (Basque Country North of Spain) in 1956. For each experience presented, an overview of the company's main activity will be presented together with the needs and opportunities behind the decision to set up the virtual team; the organisational structure adopted in each case; the dynamics to support virtuality and the best and worst practices as related by people closely involved in these virtual teams.

2. Research fieldwork

FAGOR ELECTRODOMESTICOS S. Coop. (HOUSEHOLD APPLIANCES)

Fagor Electrodomésticos is a prime example of the internationalisation process undergone by companies at MCC, consolidated as one of the major companies in the global home appliances market, operating in eight different business areas and six countries across Europe.

In order to analyse the organisational revolution brought about by Virtual Teams, we met Xabier Elizetxea, Research and Development Manager for the baking area and Rubén Igual, Project Manager. Rubén is one of the people involved in the everyday functioning of Virtual Teams and he

remembers his first experience dating back to 2001: “We want to work with the best, and they are not usually by your side. We need to integrate them at earlier and earlier stages of engineering, design, marketing, and of course, accomplish all this efficiently and cost-effectively.”

These teams, called Operational Virtual Teams (OVT), aim to gather the best human team, regardless of their geographical location, and to develop a given task in an innovative way within a fixed deadline. “It is something similar to the way the movie industry works: the director, the actors, the technicians and the producers get together to carry out a common project, work together sharing their creativity for a while, and then part to start up new projects.”

From a conceptual point of view, the structure of an OVT is similar to that of a sphere, see Figure 1. In an OVT there is only one boss, called the leader, and a base team that is usually formed by between ten and twelve people working in concentric spheres of three to four people each.

Figure 1, Operative Virtual Team: Spherical Structure

These concentric spheres are determined by the fields of knowledge which are necessary to develop the assigned task. As a general rule, in Fagor Electrodomésticos these spheres of knowledge usually correspond to the Engineering, Design, Production, and Marketing Departments of the different plants they have throughout the world. The first important feature of OVTs is that they are multidisciplinary: “This prevents them from being formed solely of experts in just one area who may set out looking at the problem from just their own point of view. As they work with experts belonging to other fields, they can look further to more daring solutions.”

The triggering factor of an OVT coincides with a meeting, ideally face to face…: “…with all the members of the team, not just with those responsible for each sphere. Having some prior physical contact is a determining factor when it comes to working virtually. It allows people to get involved in the task, creates empathy among the different members, and makes them proactive and creative in problem solving.”

These leaders are not chosen because they are particularly communicative or skilled in new technologies, but because they know a lot about the specific field they will develop, they have organisational and consensual skills, and because they are able to unify expectations and get the best out of the different team members. In this way the OVT is launched, and in its conceptual structure the leader is seen as the nucleus of the sphere and the concentric spheres are the different departments involved in the team.

Apart from the permanent members of the OVT, in this spherical structure we also find the figure of the “satellite”. The satellite, a political position within each organization, is the member that orbits outside the spheres. He or she does not take part in the OVT itself but plays two main roles: “First, in monitoring meetings he or she supervises the development of the project and might play an important role in the creativity aspect as he or she has non-technical training which might help pose interesting and different points of view. He or she will benefit from having, at the same time, a global view of the organisation and the skill to look for synergies.”

The ‘political aspect’ enables him or her to strike up conversation with other ‘satellites’ responsible for the rest of the organisations taking part in the OVT and to take decisions at the highest level; “…Resorting to political means is very rare; you are not supposed to do so unless it is a real emergency and only the leader is entitled to take this course…”

MAIER S. Coop.
Maier is part of the Automotive Division of MCC, set up in Gernika (Spain) in 1973, it manufactures plastic injection parts and groups of parts mainly for the automotive industry, but also for household

appliances and consumer electronics. Nowadays Maier has five production plants, sales of € 220 million and a workforce of nearly 2,200 people.

Given this complex, highly-competitive sector, Maier set up the MTC (Maier Technology Centre) at their headquarters in Gernika. MTC is designed to be the centre for virtual teams structuring and to coordinate the great quantity of research and development activities carried out among the five manufacturing plants distributed across three European countries

In order to get to know the organisational structure of Virtual Teams in Maier, we met Álvaro Páramo and Eneko Santiso, a Studies Manager and Systems Engineer respectively, who are involved in the everyday functioning of virtual teams: "…First virtual teams were born spontaneously to connect the diverse national and international plants and arose from the need to coordination. Things were usually coordinated over phone or e-mail, but one had to travel whenever the issue was something important"

Formally, virtual teams are framed within the structure of Project Planning Management at Maier, which specifies the people, positions and responsibilities in those groups "…which are characterised by being made up of members who cyclically go in, do their job, and leave, in order to successfully carry out projects that take an average of two years from the elaboration of the initial viability studies and the offer on the contract, to the testing of the necessary equipment prior to the mass production."

Figure 2, Operative Virtual Team: Spiral Structure

Conceptually, the organisational structure of the standard virtual team at Maier looks like a spiral, see Figure 2, which has a beginning (the initial bid for a contract) and an end (the manufacturing of the contracted parts in the plants). The person in charge throughout the whole of the project is the Project Leader (who is also the team leader) and the members of the team are determined by the different stages (or 'spiral phases') that the project goes through: "…As a general rule, all the departments in the different plants collaborate in some way at some stage of a given project, which is a practice we have found especially satisfactory as it favours the transmission of knowledge and encourages creativity within the company…"

As a result of this 'in and out' rotation in the virtual team, coordination work has to be more structured and organised than in ordinary groups. Moreover, it is difficult to gather the whole team due to dissimilar timetables in the different regions and the members' availability, among other things, which is why: "…one has to make the most of those video-conferences in which all the members of the virtual team take part, respect rules on punctuality, get to the point, don't beat about the bush, and so on. It can be compared to a "long-distance romance" in that you have to pamper and look after it much more carefully than normal if you want to "keep it alive".

Collaboration among members of the team is 'cyclical'; that is to say, each member works locally on his or her own part and shares his or her progress with the rest of the team members. It is a process we could call constructivist, moving forward along the spiral. As the project moves forward in time and completes this stage, it goes towards a follow-on phase in which some of the members of the virtual team stop or reduce their involvement while other departments from the plants join in to contribute their knowledge to the next stages of the project.

Leaders of virtual teams at Maier have long been working with this structure and agree that it works for the profile of the company and type of activity entrusted to the teams. However, they have noticed that performance and creativity fluctuate according to activity, stage, experience of the team and so on

MCC GRAPHICS S. Coop.

MCC Graphics, the graphic services division of MCC, was set up in the late 1990s as the commercial and marketing image of two already established cooperatives: Elkar and Danona. Later on, under this

virtual ‘umbrella’, they were joined by Rotok in 2001 and by Evagraph in 2005, establishing a major group in the commercial printing and publishing market. With 40% of production exported to France, the United Kingdom and Germany and total sales expected by the end of 2006 to reach €30 million, the group employs nearly 150 people.

To talk about this virtual cooperative we met Javier de la Fuente, Export Manager and Ignacio Varona, Head of Technologies, who are involved in the organisation of virtual work and technological support for the teams: “MCC Graphics is a completely different case from other companies: It was conceived to be absolutely virtual as a proactive response to reality, as a conscious gamble on creativity brought out by virtuality as opposed to the homogeneity generated by hierarchy and presence; in favour of collaboration between teams rather than competition among parallel productive structures. It is a unique new form of organisation needed to face up to the complex scenarios that dominate the sector more efficiently than would four autonomous and distributed realities.”

Figure 3, Operative Virtual Team: Atomic Structure

Conceptually (Figure 3), the structure of MCC Graphics can be compared to that of an atom, with the nucleus (protons), the joint productive structure of the different companies, remaining mainly static. Around it, the virtual teams (neutrons) orbit and provide services to this productive structure. These virtual teams can be of two different types:

- Stable Virtual Teams (SVTs) are formed by people who share the same function in each of the four different plants, along with the international branches. These people share knowledge, a common language and insight, and utilise a restricted area on the technological platform, work according to predetermined team events, etc. These stable teams are Commercial, Offers, Coordinators, Plant Managers and Production Managers.
- Project Virtual Teams (PVTs) are born of the ‘virtual resources’ of MCC Graphics and combine groups of seven to eight people, each of whom belongs to a stable virtual team with their own particular field of knowledge, goals, tasks to develop and so on. These PVTs, together with occasional contributions from other experts, “... are able to provide, in a creative way and in a very short time, solutions to problems of logistics, supplies, resource availability, etc. so as to meet orders in due time and live up to the high standards demanded by our customer.”

The first essential feature that differentiates both types of team, and which provides the PVTs with a fundamental part of their creative muscle, is that they are both emergent and ad-hoc. No meetings are held either to launch the virtual team or to get members together. On the contrary, when faced with the need to produce, let’s say, an estimate, they burst onto scene and under self-management, evolve towards their goal: “…not in a chaotic way or by defending the particular interests of their respective plants, but with all the generosity, professionalism and commitment infused by the cooperative spirit, as well as all the richness and creativity this entails.”

Another characteristic that should be pointed out is that teams neither follow an obvious leader nor select their members beforehand. On the contrary, they are teamed up through natural selection…

Finally, according to Javier:
“MCC Graphics is characterised by two key factors; firstly, by the fact that it is a cooperative and secondly, by its virtual condition. We have had to deal with distance using work routines and communication tools which are different from the traditional chats around the coffee-machine or at a desk. In this way you encourage values like generosity both at an individual level and on a team basis when it comes to the point of taking decisions that may minimise benefits to your plant in favour of another plant; values like the creativity to develop virtual tools and means of coordination with your colleagues. It also promotes a higher level of personal professional expectation to assume tasks that, due to virtuality and the lack of a rigid hierarchy, are not defined by the duties of different posts but are none the less essential to allow the project to reach a satisfactory conclusion and the virtual structure to go on.”

Managing design system evolution to control design process: methodology and tools

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Abstract: Design system management aims at improving the performance of the company and at bringing reactivity to the evolutions of customers' needs and of the constraints of the market. In such a context, one purpose of design management is to define and to organise the design system where the design transformation will take place. Companies must not only control the design process but also manage the design system. This management requires being able to understand and evaluate the design process and the activities that make it up. Objective of this paper is to define a methodology to model and follow-up evolution of design context in order to manage design process. First, we present a model describing the design context to provide a framework to manage design system. Second, we define a methodology, using the model of design context, to follow-up the evolution of the design context and to evaluate its performance. Finally, an example extracted from an industrial case study is proposed to present PEGASE, a prototype of softwre helping decision-makers.

Keywords: Design system modelling; design system evolution; design process management; risk management.

I. Introduction

One purpose of design management is to define and to organise the system where the design transformation will take place by understanding design context. This context is evolutionary and depends on all the information produced throughout all phases of a product lifecycle to everyone in an organization at each managerial and technical level, along with key suppliers and customers. Objective of this paper is to present a methodology to model and follow-up evolution of design context to manage design process. First, we propose a model describing the design context to provide a framework to manage design system. It allows identifying and defining global and local performance inductors of the design system. Second, we focus on the use of the model in a methodology for design management. It helps to analyse and follow-up the evolution of the design context to control design process. In one hand, management is predictive by estimating the impact of a decision in the design system thanks to risk management methodologies. In the other hand, management is effective during the design process progress by applying GRAI concepts developed to model and control design system. Finally, an example extracted from the using of PEGASE in a real industrial case study is presented. PEGASE is a prototype of software developed to support engineering management according to structuring of decisions making.

II. Modelling design system

Nowadays performance evaluation of design system obliges to manage activities which are more and more collaborative. So, evaluation should focus on interactions which are generating the design process. Hence, design management requires understanding of design process context in order to adapt actors' context of work if it's necessary. As it is not enough to manage progress of the design process or product data, three global performance inductors influencing the design system have to take into account to follow and manage evolution of the design system (Robin *et al.*, 2005):

- The technological factor that concerns the techno-physical environment (scientific and technological knowledge),

- The context in which the design process takes place. It includes natural, socio-cultural and econo-organisational environments (external and internal environments),

- Human and his different activities during design process (actors).

Robin *et al.* have also identifed local performance inductors that are specific to the design system. These inductors concern the product, the process and the organization. They permit to define and take into account relationships and influences between each element of the design context. Interactions between these local inductors offer a vision of the design system evolution. In the provided model, considering each performance inductor influencing the design system, at each step of the product lifecycle, at each decision level (strategic, tactical and operational) allows obtaining a global description of the design context. Then, interactions between each inductor give a vision of the possible evolution of the enterprise and of the design system.

III. METHODOLOGY TO FOLLOW DESIGN SYSTEM EVOLUTION

To favour achievement of the design activities, the actors of the design must have a set of coherent and contextualized information constraining their activity. The definition of this set of information is possible only if the system is modelled, if its dynamic is described and if the performance inductors (global and local) are identified. This obliges to model the enterprise, its design system and to study the evolution of this whole.The GRAI model and associated concepts offer a general framework for the modelling and the follow-up of the evolution of the company, the design system, its processes and its activities. Sperandio's approach (Sperandio *et al.*, 2004) provides models of the company and GRAI Engineering method (Merlo and Girard, 2004) models of the design system. Thanks to these model Sperandio et al. (Sperandio *et al.*, 2007) propose a predictive management of the system evolution by estimating the impact of a decision in the design system thanks to risk management methodologies. Concerning evolution of the design system, the GRAI R&D model and the design environment concept (Girard and Doumeingts, 2004)(Girard and Robin, 2006) allow controling the evolution of the design process and the design activities during the design process progress. Description of the whole system makes it possible to define the objectives, the action levers and performance indicators which composed a Performance Measurement System. Thanks to such a modelling a modification on one of them causes the re-examination of the objectives, the action levers and the performance indicators in order to be always in adequacy with the object to be evaluated. This methodology of modelling and follow-up of the company and the design system is build around four stages:

Stage 1: Modelling of the company and description of the global performance inductors,

- Definition of three different models to control system evolution (Sperandio *et al.*, 2004):
    - Functional model,
    - Organic model,
    - Operational model.

Stage 2: Follow-up of the evolution of the company,

Stage 3: Modelling of the design system and description of the local performance inductors,

Stage 4: Follow-up of the evolution of the design process and the design activities.

IV. SOFTWARE TOOL SUPPORTING DESIGN PROCESS MANAGEMENT

To help decision-makers to manage design process at each decisional level we developed a prototype of software: PEGASE. It integrates all the concepts described before. It permits the modelling of the system and the follow-up of the evolution of the design system and of its context. To show how PEGASE could provide a relevant answer to the problem of design system management, we present an industrial case study concerning the design phase of the reaction engine mast of the Airbus A380. This element is designed by the design department of an Airbus plant in Toulouse and has interactions with the wing (designed by Airbus Industry in England) and with the reaction engine (designed by a subcontractor in United States). Experience of strategic project managers of Airbus allows defining a global structure of the plane. When this structure is described, design departments which have to work together are identified in the structure of the enterprise. This identification depends on the decisional and organizational structures of the company. Finally, the strategic decisional level proposes a general design process to achieve properly design objectives. We obtain a global description of the company, of the design system and of the design process that are modelled in the PEGASE software. Objectives, action levers, resources and performance indicators for each plant, at each decisional level but also relationships and influences between each plant and each department of them are defined and appeared in PEGASE too. When all elements and interactions in the design system are identified and implemented in the PEGASE software, projects could be created and software will manage their evolutions.

At the beginning of a project, thanks to PEGASE software, tactical project manager of each department know his partners and has to initialise internal or external collaboration identified by the upper decisional level. He has especially to create and control workgroups according to knowledge, distribution, culture, collaborative capacities, interoperability of each human and material resource and regarding to design objectives. PEGASE proposes to project manager a specific Graphical User Interface to control his activity and to create and follow-up workgroups by creating specific design framework (see figure 1).

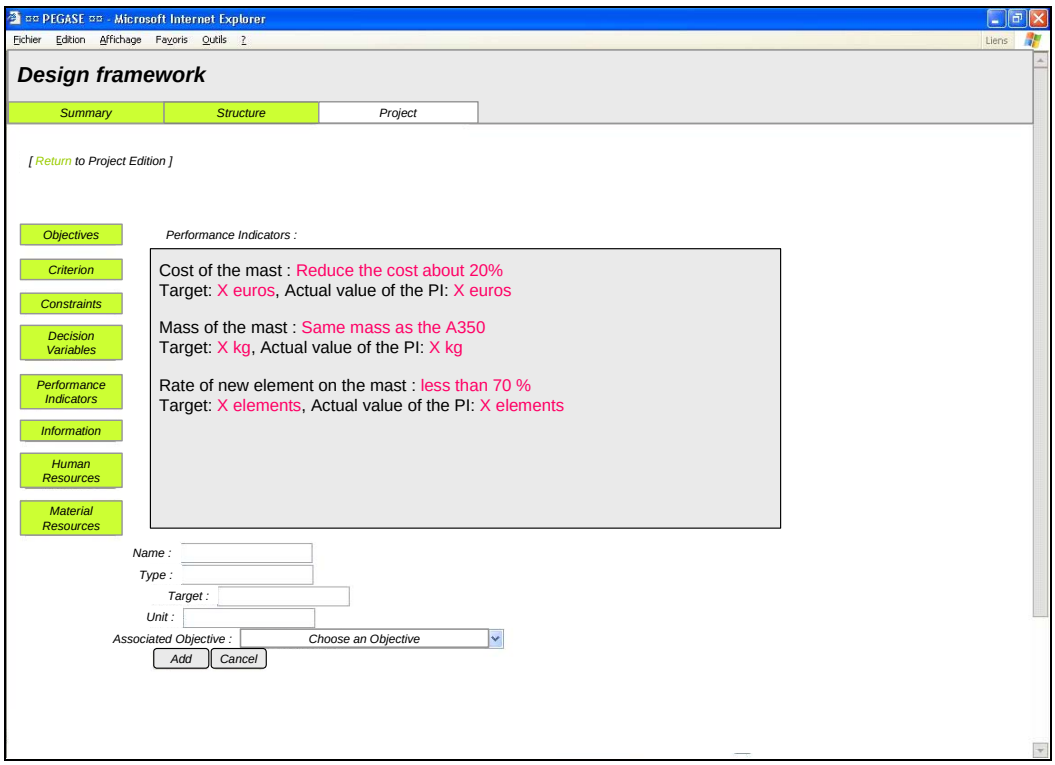

Figure 1. Example of Graphical User Interface dedicated to a decision-maker at a tactical level

At an operational level, collaborative design activities regroup actors distributed in each plant. Each actor's task is defined and PEGASE provides to each one a set of contextualized information on a specific GUI about his context of work (human and material resources, distribution of these resources, objectives, constraints, influence of the others actors…). This decisional level provides tangible results on the product and information about collaboration that are capitalised and send to upper decisional levels by PEGASE. PEGASE permits to control collaborative activities by the mean of an adapted product model and a specific design system model. All these elements are contained in an organizational model and managed in PEGASE too. PEGASE is developed around an integrated product, process and organizational model, completed with a specific PMS to obtain a dynamic system for design process management.

V. CONCLUSION

Product design today requires new interaction forms between the various stakeholders involved in this specific process. Management of the design processes is today complex and to improve processes performances, it's necessary to focus not only on the artefact but also on the actor's relations. Therefore, organisation has to integrate aspects centred on the actors in order to be reactive and efficient considering the design process evolution and framework. Software tools must be set up in order to support those aspects. This paper focuses on a model describing the elements influencing the design context of engineering design actors and interactions between them. It presents global trends while considering the design actors and defines a methodology to manage design system evolution. In a first time, the decision-making structure of enterprise is defined precisely with Sperandio's approach to put in evidence internal and external links between each component of the system and its evolution is estimate thanks to GEM approach. Objective of this phase is to underline the rule of each actor, at each decisional level, and to judge his influence on the design system thanks to risk management methodologies. Secondly, GRAI Engineering method permits to describe the design system to manage its evolution. A performance measurement system is developed according to the decision-making structure and previous different models. It has also to integrate actors' influences. Lastly, the GRAI R&D reference model and the design environment concept give the frame to implement the result of the two previous phases and to control design process. In order to validate this framework, we developed a prototype of software: PEGASE. PEGASE helps decision-makers, at each decisional level, to manage design activities. The aim of this work is to support decision makers managing design projects.

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Innovation encounters: ecosystems and entrepreneurship in cross-national alliances

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Abstract : Based upon emerging research and field interviews with alliance leaders in U.S. organizations, this paper reports findings that highlight the roles of ecosystems and entrepreneurship in fostering innovation in the context of cross-national alliance management in four sectors. Particular attention is paid to the professionalization and institutionalization of an alliance management capability and to a focus on 'ecosystems' as a unit of analysis and operation. Three practical critical success factors are identified as well as possible constraints.

Keywords : Alliance, Ecosystem, Entrepreneurship, Innovation

I. Introduction

Today there is great interest in linking alliances and innovation both in theory and practice. About a decade ago, Powell et al (1996) argued that innovation occurred in 'networks of learning' in the biotechnology sector. Since that time, work on 'networks of learning' has extended to many sectors, focusing first primarily on factors facilitating the formation and structure of formal alliances for a wide range of purposes and across a wide range of national and regional boundaries. More recent literature examines alliance capabilities (Heimeriks and Duysters, 2007), alliance performance (Sampson, 2003), alliance termination (Hyder and Eriksson, 2005) and alliance learning (Inkpen and Pien, 2006) to name a few categories of inquiry.

Practitioners of twenty-first century alliance endeavors report that they see a qualitative change in business models for today's alliances, compared even to the alliances of the nineties. This paper attempts to capture the confluence of several streams of thought that delineate this change. These include more in-depth work on 'tacit' knowledge in alliance networks and alliance learning processes; recent studies of innovation models that highlight the role of networks and alliances; and new work that compares knowledge networks to formal alliance networks.

What is this qualitative change itself and what are the implications of this change for alliance management and innovation? I argue that we need to recognize an 'ecosystems' view of alliances to capture this 'innovation' in alliance operations. Such an approach recognizes both the enormous complexity of today's alliance environments within and across sectors as well as the significance of interorganizational and intercultural contexts for innovation. Using the 'ecosystem' as the unit of analysis or focus fosters both a stronger understanding and a richer practice related to entrepreneurship opportunities in a range of sectors. Indeed, there is a new way, now being institutionalized, of managing alliances as ecosystems for innovation.

II. Alliance innovation, ecosystems, and entrepreneurship

Recent work on innovation captures the important role of alliances in fostering and sustaining innovation. Using the model of Procter and Gamble Corporation, Huston and Sakkab (2006) highlight the need for external connections such as those in alliances in promoting innovation; this replaces the older focus on the internal R&D function alone to promote corporate innovation. It also parallels recent work on the increasing need and effectiveness of user centered innovation. (See, for example Von Krogh and Von Hippel, 2006 who discuss these issues in the context of open source software.)

This way of looking at things, including business models, calls for an ecosystem approach. Such an approach goes beyond but includes looking at network connections and even links to users. The term ecosystem stems from biology and ecology where it encapsulates the study of a biological organism in its environmental setting, paralleling a systems approach.

Today several of the interviewees in my sample use this terminology and several recent works in the business field are also using this terminology (Adner (2006) with a focus on innovation; Iyer, et al (2006) with a focus on the software sector; and Singer (2006) with a focus on marketing). To be precise, I define an ecosystem as both the network of organizations involved in a formal alliance and the connections and characteristics of the environmental setting of both each individual, participating organization as well as of the current (or planned) alliance as a whole. Such a definition incorporates what I am learning from those I interviewed plus what the literature is beginning to capture: the need to think in terms of sets of organizations and their settings including resource configurations, potential markets, regulatory windows, and the like. I argue, indeed, that this approach also parallels the need for ecosystem-like approaches in a wide range of other fields today, many of which are also converging.

Adopting an ecosystem approach, both tactically and strategically also complements a new energy in the field of entrepreneurship. See, for example the 2006 issue of Management Science focusing exclusively on entrepreneurship (Shane, 2006) or the work of Teng (2007) that looks specifically at alliances and entrepreneurship. While there is no one definitive definition of entrepreneurship as applied to alliances, Doz and Williamson (2002) provide an early and helpful foundation in examining "alliances as entrepreneurship accelerators". Alliance capabilities and potential can facilitate entrepreneurial behaviors and activities, thus contributing to knowledge creation and innovation. An example is the alliance that created the i-mode mobile internet service in Japan (Peltokorpi et al 2007).

Finally, the ecosystem, entrepreneurship, and alliances approach I discuss here provides an answer to the tension between work on knowledge networks (informal transfers of knowledge in networks measured by citations in the patent literature) and transfer of knowledge in alliances (Okamura and Vonortas, 2006).

III. Research findings

This paper reports on findings from interviews with cross-national alliance leaders in eleven organizations headquartered in the United States. It is part of a larger study of transatlantic alliances in the information technology/hardware/software; telecommunications and electronics; semiconductor; and pharmaceutical/biotechnology sectors (Levinson et al 2006). The interviewees occupy high-level positions dedicated to the alliance function in their corporations. They come from companies headquartered along both coasts of the United States. Each one has a title such as Vice-president with responsibility for alliances in the corporation or Manager of a specific alliance or set of alliances and each brings a background distinguished by both managerial and technical expertise. With regard to sector, six are in the information technology and hardware/software sectors, four are from the pharmaceutical/biotechnology sector, and one is from the semiconductor industry. Two of these interviewees are women executives in the information technology field. All of the eleven report prior experience with the alliance form and all have strong interpersonal and cross-cultural communication skills.

The interviewees come from and note a variety of structures both within and across sectors. In the pharmaceutical/biotechnology field there appear to be different patterns with regard to alliance management and alliance structure. Here U.S. alliances involving at least one biotechnology/pharmaceutical company are often smaller (for example, one major pharmaceutical/biotechnology corporation partnered with one small pharmaceutical/biotechnology company focused on R & D for a specific drug or purpose) and a joint management and research

team for the alliance. While a small biotechnology company may have one or a handful of these, the large pharmaceutical/biotechnology firms have many such alliances. In fact, one interviewee at a major pharmaceutical/biotechnology multinational refers to the multinational as the 'mother ship' with separate alliances with smaller companies or university researchers but without shared teams. That large pharmaceutical/biotechnology multinational avoids the shared team structure. (Such an approach allows the 'mother ship' to protect itself from unintentional knowledge spillovers.)

The U.S. interviewees report a complex structural pattern for alliance management. A majority have a corporate function for alliance management where there is a vice president or other top executive who has responsibility for all corporate alliances. This function works closely with managers of specific alliances from around the world. Often these central executives have a training function. Here they are increasingly focusing on the creation of effective 'interlock and business plans' at the alliance level. This training can be both virtual and at corporate headquarters; often it involves a corporate wide identification of skill sets and tools to ensure effective 'interlock'.

Most recently, there has been the emergence of a marketing function for alliances in their corporation globally. This marketing function involves the promotion of strategic alliances at the local level and the design of incentives to foster the growth of alliances that support the corporation's strategic directions. This is consistent with the use of an alliance portfolio approach at the corporate level. Having such functions at the corporate level links directly to the focus of this paper. It corresponds to the new focus on the ecosystem as a unit of strategic analysis. Additionally, it is primarily at the local level where those 'on the ground' have a stronger understanding of the distinctive characteristics of specific local business environments including potential resource configurations.

The central unit is, of course, concerned and charged with monitoring alliances as well as with quantifying the benefits of alliances for the corporation. This is an important trend and complements earlier work highlighting the presence of more central alliance management approaches in the U.S. than in Europe (DeMan, 2005; Levinson et al, 2006). This professionalization and institutionalization of alliance management in large U.S. corporations is a significant development. (Paralleling and possibly catalyzing it is the growth of both professional associations supporting those in alliance management functions and of consulting organizations with divisions or increasing numbers of their consultants focused on alliance management training and implementation support and counsel.

Based upon my data, the central U.S. unit includes the aforementioned alliance training and portfolio functions as well as the presence of 'tiered' approaches. As the number of alliances grow and environments increase in uncertainty and complexity, U.S. corporate alliance managers are increasingly noting their use of 'tiering' in alliance management. They organize all their company's alliances into usually three or four tiers. (Note that the interviewees in the pharmaceutical/biotechnology firms do not report such approaches; this is probably due to the fact that alliances in their sector are, for the most part, structured quite differently from the other sectors.) The tiers seem to follow similar structuration across companies: the top tier is composed of alliances with major competitors or partners involving other long term and/or multiple alliances; the second tier is that group of alliances where the corporate executive feels there is the most possibility for growth and payoff (this is the tier to which the interviewees report giving a greater portion of their attention); and the bottom tier or two, are those alliances requiring lesser attention.

Overall, US interviewees observe a current growth pattern in alliance formation and, in particular, in cross-national alliances and predict future growth, especially in cross-national ones. Most importantly, they report a new comprehensive view of alliances. As one interviewee at a major information technology-related corporation notes, he has seen a change since the middle of the nineteen nineties in alliances his corporation and others are forging. His observation is that the

earlier alliances in his field formed in order to "pump up sales"—just the mere announcement of an alliance could increase sales! Compared to the earlier days of his career working with alliances, he sees current alliances as 'substantive' in nature. "We can partner and we can compete". Here the focus on 'substantive' marks the change. It is consistent with using the 'ecosystem' not just as the unit of analysis but also as the unit of focus plus action. This, I argue, is a dramatic and not an incremental change. It reflects the institutionalization or regularization of thinking about alliances in new ways—ways that have the '*inter*'organizational perspective in place of the older 'organizational' perspective (Levinson, 2005). Additionally, it reflects the recognition of the importance of environmental settings (and, especially cross-national settings), their characteristics, and their resource configurations in which alliances and potential alliance partners are anchored.

IV. Conclusion: critical success factors

This examination of interview data and the literature indicates several critical success factors for fostering innovation in the alliance setting. First is the need for a central and professional alliance management function. Second is the question of actual location and here, an ecosystem and entrepreneurial approach would argue for both central and decentralized functions and coordination. Thirdly, there is the need to understand and implement an ecosystem approach itself both at tactical and strategic levels: this amplifies the power of entrepreneurship in alliances, allowing for a focus on tacit (rearranging the letters in tactical!) knowledge transfer as well as on strategic elements of alliance configuration and operations. There are, of course, constraints on this approach including a lack of long term and cross-national as well as cross-cultural data on the impact of an ecosystems approach and the use of entrepreneurial activities in alliances.

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Proposal for a Decision-making process in Regional planning: GIS, Multicriterion Approach, Choquet's Integral and Genetic Algorithms

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Abstract: Our contribution consists in developing a new design approach based on a methodological step which brings a relevant help to the territory's decision makers in the realization of various regional planning projects.
In this paper, we propose a flexible decisional step for regional planning .The proposed so-called spatial decision support system (SDSS) PRODUSMAGAT, which is devoted to help deciders in spatially-related problems, integrates several variants contributing to better analyze territorial context. The essence of this paper is to present a strategy for integrating Geographical Information Systems (GIS) and Multicriterion analysis (MCA) namely Electre III, approaches of sorting (ordinal and nominal), while optimizing the aggregation phase. This is by considering the interactive aspect between the criteria and exploiting fuzzy measurements (Choquet's integral). Also, our study aims at improving quality of the decision brought to the process by integrating Multi Objective Genetic Algorithms (MOGA).
In the present article, we will focus on the treatment of two territorial problems: the first relates to the search of a surface better satisfying certain criteria. The second consists in realizing the land use plan.

Key words: Spatial decision support system (SDSS), Regional planning, Multicriterion analysis (MCA), Geographical information system (GIS), Multi Objective Genetic Algorithms (MOGA).

I. Introduction

1. Study Context

Decision-making procedures, resulting from operational research are proving badly adapted when the decision relates to an open system, which integrates different dimensions such as economic (optimization of cost and production), social (impact on health, etc.) or environmental .
This report is due to the fact that a decision implies, on one hand the existence of several criteria and, on the other hand, an opposition among these criteria. The various criteria intervening in a decision are obviously not appreciated in the same way as if the decision maker changes or the place (or moment of decision) is different. This sensitivity of decision to external factors reveals its subjective composition.
Slowinsky[1] has perfectly referred to the subjective content of any decision: *"A multicriterion problem does not have a solution, if additional information is not considered, namely the preference of decision maker"*.
Since decisions do not have a solution without the contribution of preferences, the existence of an optimum is questioned. The absence of optimum in some problems has been formally approached by Roy (Roy 1981). The latter explains why the existence of an optimal solution is conditioned by three constraints:
1. Each considered solution is exclusive of all the others;
2. The considered solutions set is fixed once and for all;
3. Solutions can be ordered in an undeniable way from the worst to the best (transitivity).

2. Problems and contribution

Considering the context of this work and the social and environmental implications of decisions, it is obvious that the first two conditions are extremely restrictive and barely verifiable in reality. The transitivity of decision maker's preferences is probably the most constraining optimization condition.

(Roy 1981) explains that decision maker's preferences are often fuzzy, incompletely formulated and no transitive. Moreover, they tend to evolve during the decision-making process.

In (Eastman and Toledaro 1994), the author has approached the best adapted site for a factory of carpet manufacturing. In (Scharling 1997), many applications of multicriterion methods concerning the

[1] Actes de séminaire à l'Ecole Polytechnique Fédérale de Lausanne.

environment management and especially localization with a relatively restricted number of variants have been described. In (Joerin 1997), MEDUSAT is proposed for the localization of waste treatment site.
How to face the complexity of urban problems and how to use the ground in a measured way by considering all territory characteristics?
In other words: Which SDSS is it necessary to adapt to the environment field?
These arguments have encouraged us to propose **PRODUSMAGAT** (an SDSS by the use of GIS, Multicriterion Methods and Multi Objective Genetic Algorithms for Regional Planning).
Here, two problems in regional planning are treated, namely:
1. Problems which consist in searching for a surface better satisfying certain criteria, such as the localization of an infrastructure administrative: building, factory, station of purification, etc.
2. Problems which consist in designing a polygon network where each polygon determines the type of land use, such as the design of plans of zones.

II. Methodologies, tools and techniques for investigation

PRODUSMAGAT integrates mainly the following components:

1. Territory Model
The use of this model contributes importantly to the context description and the planning variants identification. Constituted by Geographical Information System (GIS) and simulation models, it constitutes the support of spatial analysis functions (5A) (Joerin 1997): Abstraction, Acquisition, Arching, Display and Analysis.

Thus, when decision makers manage to identify actions and criteria, spatial analysis procedures allow affecting to the various actions, a value (mark) for each criterion. The set of actions and their marks for various criteria constitutes the evaluation matrix (or the performances table) which is managed by the GIS. Actions are attached to places and the evaluation matrix can thus be represented in the form of chart (Hamdadou et al. 2006).

2. Multicriterion Analysis Tools
The comparison between various actions is then carried out by the use of multicriterion analysis methods. The latter allow generating one or more proposals. They are used to synthesize geographical information in order to select the variants satisfying the decision maker's preferences (s). Criteria can be quantitative and/or qualitative. This kind of method is well adapted for the urban projects evaluation.
The choice of multicriterion method should consider, on one hand, the nature of the problem to be treated and, on the other hand, choices (tastes) of decision makers.
Selected method should also respect their value scales and especially their perception of exchanges between its various treated dimensions. The five types of planning problems (Joerin 1997) should be treated with different approaches as well as their realization. Nevertheless, different approaches are similar in their principle. In our work, we adopt ELECTRE III and the sorting approaches to ensure the multicriterion analysis (Roy 1981).
3. Sorting Problems
Sorting problems consist in formulating the problem in terms of object assignment to a preset class.
According to the structure of the problem, categories can be ordered or not ordered (Hamdadou et al. 2007). We distinguish mainly two kinds of sorting:
Ordinal sorting
In this case, classes are ordered and characterized by a sequence of limiting reference actions. Each category is represented by two families of reference actions, one is inferior (constituting the lower limit) and the other is superior (constituting the upper limit).
To treat the first problem, PRODUSMAGAT applies the ordinal sorting to the set of actions belonging to an area on the chart such that the number of categories equals three;
The low category A_1 formed by very bad issued actions, the category A_2 gathering the sufficiently good issued actions (actions which define the required site) and the category A_3 including actions which can be classified neither in A_1, nor in A_2.

Nominal Sorting
The case where categories are not ordered and are characterized by one or more standard actions (actions of central reference or prototypes). It aims at helping the decision maker to choose classes the most possible to the assignment of an action A.
To treat the second problem, the decision maker can choose various kinds of land use, and then he defines for each one a prototypes set. It is necessary, thereafter, to apply the nominal sorting. The latter will allow assigning each action to a type of land use.
Among multicriterion classification methods of decision-making destined to solve this category of problems, we mention: Trichotomic segmentation, ElectreTri (Bouyssou and Dubois, 2003) and PROAFTN (Belacel 2000).

4. Fuzzy Measurement and Choquet's Integral

All the multicriterion methods use the arithmetic weighted average to incorporate information characterizing decision maker's preferences on the set of criteria. This supposes that criteria are preferentially independent. However, in reality and especially in such a complex field as regional planning, criteria interact and the assumption of preferential independence is seldom checked (Marichal 2003).
In this section, we deal with the aggregation problem of interactive criteria and we introduce fuzzy measurements as solutions to this problem (Hamdadou et al. 2007).
Fuzzy measurements allow solving the problem of compensation between criteria in the aggregation phase. This is by defining a weight on each subset of criteria. And, the fuzzy integral, more specifically Choquet's integral, is the balanced aggregation operator able to consider this interaction. Fuzzy measurements have been proposed by (Sugeno 1974) in order to generalize additive measurements. It is well-known now that, in many situations of real world, additivity is not a suitable property for the overall functions, because of the absence of additivity in many facets of the human reasoning. As for expressing human subjectivity, Sugeno has proposed to replace the additivity property of overall functions by monotony and called these monotonous measurements as nonadditive fuzzy measurements.
This report has led us to use discrete Choquet's integral as an aggregation operator in both sorting methods. This operator aims to improve the multicriterion analysis power by generalizing the arithmetic weighted average (Hamdadou and Labed, 2006).

5. Multi Objective Genetic Algorithms

Evaluating the performance of a multicriterion method requires the following three criteria:
Criteria 1: An effective multicriterion method should still indicate the best alternative (action) when a non-optimal alternative is replaced by another worse one.
Criteria 2: The alternative classification by an effective multicriterion method should meet the transitivity property.
Criteria 3: Let us suppose that a multicriterion problem is divided into a set of smaller problems. Each problem has two original decision alternatives and criteria. Let us suppose later that the classification of the smallest problems meet the transitivity property. According to this criterion, when all the classifications of the smallest problems are combined together, the whole new alternatives classification should be identical to the whole original classification before dividing the problem.
(Wang and Triantaphyllou, 2006) have used these criteria to evaluate the performance of some multicriterion methods, namely Electre III. The irregularities noticed in this method are due to the unstable results provided by the step of distillation which is used in its exploitation phase.
(Lopez 2005) has proposed to solve these irregularities in the field of students' selection by the using of the multiobjective optimization.
In this paper, we suggest to solve the irregularities of Electre III in Regional planning by the using of Genetic algorithms according to a multiobjective optimization MOGA.

III. PRODUSMAGAT Presentation

Among the most famous decision models we cite: Simon's model (Simon 1977), Pictet's model (Pictet 1996) and that of Tsoukias (Tsoukias 2004).
The multicriterion and complex nature of spatial problems makes that the linear model of Simon and its extensions insufficient to answer the decisional complexity of these problems. They neglect three key elements of the decision-making in a spatial context: Participation, Negotiation and Consultation.
Territorial and urban decision-making processes, such as those of R.Laouar (Laouar 2005), F.Joerin (Joerin 1997) and S.Chakhar (Chakhar et al. 2005) produce conceptual executives integrating these elements. The decision-making model (Figure 1) adapted by PRODUSMAGAT includes three principal

phases covering spatial decisional problems as a whole:
Phase1: Model Structuring: apprehending the behavior of the system under investigation.
Phase2: Model Exploitation: choosing the aggregation procedure, optimization of aggregation by using fuzzy measurements, optimization of the performance matrix management by using Genetic Algorithms , integration of participative approaches and negotiation processes **.**
Phase 3: Concretization of results: analytical part of the process, it is also the validation part.

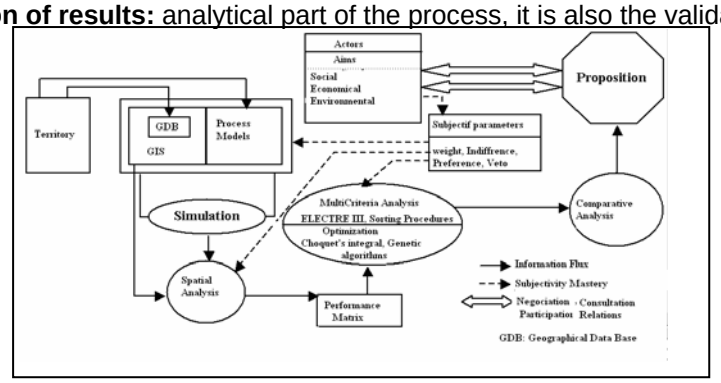

Figure 1. The Decisional Model suggested

IV. Conclusion

Among lot of case studies, PRODUSMAGAT localizes the most adequate site for the construction of a new road station in Oran. Indeed, the new road station is a project under development in the new Street Hai El Yasmine located in Oran east. Thus, the geographical data base used in our case study is the plan of occupation of ground (POS) of Hai El yasmine. The following environmental criteria are identified according to the availability of data and characteristics' particular of the zone to study: Surface of the land, Proximity of an important road axis, Accessibility: to avoid the residential districts, Sound Harm generated. Also, its Position must be at the end of the town of Oran and not in the center.

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Integrating Innovation in the Regional and Inter-regional Oil and Gas Supply Chain: case studies from a trans-regional research network

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Abstract:

Keywords: supply chain integration, value-adding partnerships, innovation, inter-regional networking

I. Introduction

The paper provides examples from a distributed action research based project on the integration of SMEs in the larger supply chain, highlighting an evolution in the view of regional SMEs as a potential source of value-creation. The examples are taken largely from the oil and gas regions of Western Australia and the UK, and from the automotive industry in Germany and Brazil. Experiences from these regions suggest current approaches have moved from an emphasis on cost-efficiency savings, to an emphasis on value-creation through innovation, based on the application of local knowledge and expertise that SMEs can provide. The presentation will outline the role of a collaborative action research-based initiative that has acted as a catalyst in identifying the issues, and fostering benchmarking between organisations in the UK North Sea oil and gas region and their counterparts in the Western Australia oil and gas region, and in the German/Brazilian automotive supply chain (Jaegersberg et al, 2005). Parallels are also drawn with other distributed networked sectors in e-business and in e-health that appear to validate some of these outcomes.

A recent report to the European Community on R&D and Innovation in Europe (Aho, 2006) underlines the perception that while more resources for R&D and innovation are a necessity, they are in themselves insufficient as a means of achieving the goal of an innovative Europe leveraging the diversity of local, community based knowledge to competitive advantage. The authors argue that e-business and regional supply chain clusters are now providing examples of how better coordination of a diversity of local knowledge and expertise can provide good models for this in the regional supply chain, giving examples from a trans-regional project on the automotive and oil ad gas supply chain.

II. The Australian Example: benchmarking innovation strategies

The Australian Pilot study is in one of a number of regions where researchers and students on placement have used collaborative action research with a range of stakeholders in the supply chain to identify (a) gaps in practice (b) rewards, penalties and barriers (c) stakeholder requirements (d) opportunities for supporting SMEs as a source of innovation in the regional supply chain. Often crucial gaps and opportunites are not transparent, and can be addressed by better communication and alignment of existing regional resources. One gap identified, for example, was the difficulty of securing funding and support for field testing of innovative developments. Another was lack of prior knowledge of future requirements for large operators, such that SME innovations were in line with regional needs. Equally, there was a lack of awareness among large and medium sized operators of technical innovations by SMEs in the region which could address operational problems they were encountering.

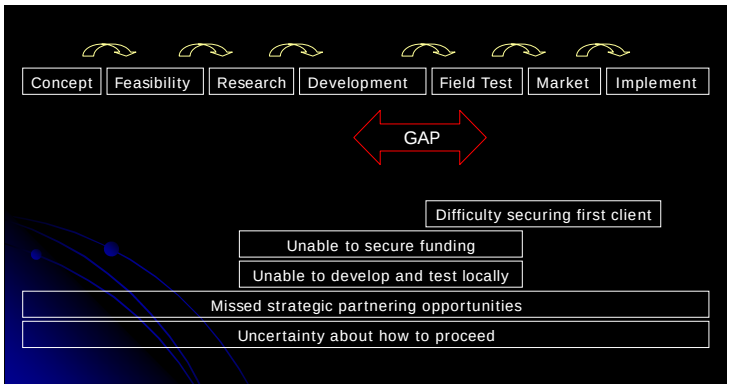

Fig. 1 Final Report Tabara S. (2006) Identifying Barriers in the WA Oil and Gas Supply Chain

The research has been extended to different sectors and with a range of reference groups, moving from open ended interviews and observation studies, to validation with further reference groups, and wider, more formal validation by questionnaire based on the issues derived from this initial phase. In some cases. This has facilitated collective understanding of the barriers faced by SMEs with regard to innovation, and provided a template for development.

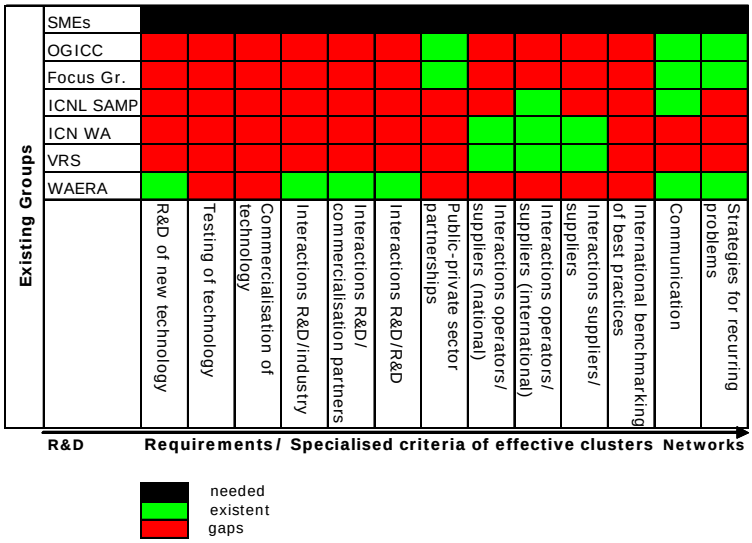

Fig. 2 Final Report Tabara S. (2006) Identifying Gaps in the WA Oil and Gas Supply Chain)

III. Other Sectors and Studies

Interestingly, many of the problem: solution scenarios were similar across regions where this work has been done, both in the automotive and the oil and gas sectors in Brazil and Germany (Jaegerberg et al 2003; Ure et al 2005). The role of this trans-regional project has been to allow regions at different stages in the supply chain life-cycle in these industries to benchmark experiences, and support the integration of SMEs in ways which foster and highlight their role in adding value to the supply chain through targeted innovation, and highlight their role in contributing to the economy of the region as key source of employment as well as knowledge transfer.

IV. From cost-cutting to value-adding: the UK example

The UK North Sea oil industry supply chain has provided an opportunity for benchmarking approaches to competitiveness for other regions in different ways, at different stages in the lifecycle.

1. Phase 1: Competitiveness through cost-efficiencies

The initial approach to competitiveness is epitomised by the CRINE[1] initiative. This provided a flagship example of cost-efficiencies based on standardisation, scaling, and strategic alliancing of resources to common ends. This was seen as a major initial success in reducing costs to allow UK company consortia to compete, however a number of aspects of these lean strategic alliances combined to undermine many regional SMES (Gray 1995).

- SMEs often absorbed higher levels of risk, and had to cut costs and profit margins to unsustainable levels within the supply chain
- Outsourcing to other countries meant many local SMEs were excluded
- Standardisation constrained innovation, and added costs for SMES in new software and hardware

Many local SMEs disappeared, together with much of the local and the specialist technical knowledge associated with deep sea drilling technologies, and undermining the ability of the region to achieve a knowledge-based advantage in a very knowledge-based market. It has also been noted that a great deal of the innovative advantage is also derived from the adaptation of existing technology to suit local conditions and requirement, and where local knowledge of

2. Phase2: Competitiveness through innovation

The PILOT initiative http://www.pilottaskforce.co.uk/ moved the emphasis to adding value through SME led innovation when cost-efficiencies and standardisation efforts had progressed far enough to mean that other factors such as innovation were becoming more significant differentiators. This was most evident in the development, adaptation and use of technology in the difficult environment of deep sea drilling. Local SMEs have a crucial role here, not only in leveraging their local knowledge and expertise, but in sustaining regional employment, in supporting LMEs and MLEs in the region, and in the attractiveness of that region as a base for these companies. The percentage of local SMEs now in the regional supply chain is around 80:20, compared with a low of 20:80 in the CRINE era. The PILOT organisation itself also acts as a high level broker for negotiating agreements on shared practices that can facilitate fairness as well as efficiency, such as contracting practices and the speedy payments of invoices, both of which penalised SMEs heavily in the past.

V. Support Strategies for SME-based Innovation in the Regional Supply Chain

The collaborative action research process has facilitated opportunities for collaboratively identifying and sharing evidence of barriers and gaps, as well as benchmarking strategies used in other regions at different points in this process. These have included:

- The communication of future development plans of large and medium sized operators in the region at Share Fairs with coordination of direct contacts and support from funding agencies and knowledge transfer partnerships with regional Universities.
- Good practice in contracting and payment that do not penalise SMEs
- Opportunities for brokering and coordination of the efforts of education, industry and government

1 Cost Reduction in the New Era

- Opportunities for collaborative identification and alignment of requirements across regional stakeholders
- Opportunities for benchmarking across clusters and regions sharing problem: solution scenarios.

VI. Conclusion

1. Reuse not Reinvention

Most recently the experience of supply chain enhancement in Aberdeen (Cattanach 2007) has been the basis of collaboration with the agencies involved in the study in Western Australia addressing common issues, but at different stages in their respective supply chain lifecycle. One of the issues apparent from different studies of technology-based development in business, education, engineering and health projects has been the recurring socio-technical nature of many problem: solution scenarios in the design of ICT supported systems, and the potential for benchmarking in these contexts.

2. Unity in Diversity

Sawhney and Parikh (2001) highlight the competitive advantage afforded by leveraging the knowledge and resources of local communities in distributed networks, as Napster or Amazon do. The Report of the Independent Expert Group on Research, Development and Innovation to the European Community, (Aho, 2006), suggests that a paradigm change is needed in which EU values are preserved in a new social structure. We argue that the models of innovation and competitiveness in the regional and trans-regional supply chain and in e-Business provide good examples of such a paradigm - leveraging the diversity of local knowledge in regional SMEs in ways that enhance the competitive advantage of regional and trans-regional clusters.

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Using Organizational Intangible Assets for Better Levels of Operational Efficiency

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Abstract: This paper presents how to use the so named intangible assets as a competitive advantage to achieve a better level of efficiency within an organisation. In order to do that we consider that the effective identification of the contribution of the intangible assets can be used to help estimate the real level of operational efficiency, which in turn is used to rationalise the performance of the activities to transform goods (products) and services. Additionally, we proposed one classification of intangible assets and we identify both attributes and variables that can be used as a basis to manage such assets. Moreover, the paper presents alternative ways to use intangible assets to define better levels of operational efficiency in the manufacturing activities.

Keywords: intangible assets, efficiency and organizations.

I. Introduction

In order to structure the set of activities necessary for pursuing a specific aim, every organization must define what its core competencies are. For Cavalcanti (2001), these competencies would be defined from the set of abilities and technologies developed that allow the organization to offer benefits to its clients.

Angeloni (2002) proposes a model for research and organization development that strives to actuate knowledge as an essential production factor, treating it as a repertory of individual and group knowledge. The repertory is seen as a valuable asset for understanding and overcoming environmental contingencies, and is described as having three interactive and interdependent dimensions: the infra-structure dimension, the people dimension and the technology dimension. Angeloni´s infra-structure dimension would be equal to Cavalcanti´s (2001), who defines it as structural capital (knowledge fluxes that are systematized – systems, methods, culture and values) this being the only asset effectively owned by the organization, and in which the idea of ownership of this asset is viewed as a decisive factor in the most efficient management of the production activity. What Lev (2002) calls organizational infra-structure would be the asset (intangible) which counts the most and which is least known: "the motor that creates the largest value out of all the assets".

Individual and collective can be augmented by intangible assets, the definition of which is neither concise nor uniform. In order to define the internal intangible assets effect, we shall initially use the taxonomy advanced Dias Jr. (2003) which defines internal intangibles as organizational resources that the company utilizes. Their correct application generates results in the form of products (tangible and/or intangible) derived from a specific organizational structure (internal concepts targeting to increased value), applied to the production of goods and services that aim to generate perceived benefits.

The identification of intangible assets for the growth of organizational performance is born out of the need to provide supply differentiation. This supply embodies the perspective of superior value attributed to products and services, derived necessarily from the organizational capacity

to contemplate distinct market demands. Thus, it becomes necessary to analyse the way that internal intangible assets energize organizational performance, with a focus on the efficiency of production operations, thus demonstrating the relevance of these assets in maintaining better levels of economic performance of organizational activities.

At the same time, research suggests that there is a need for management methods that are adjusted to goods production (tangible and/or intangible assets) with the goal of providing constant revision of the means to instigate operational efficiency, by identifying potential intangible assets.

II. Intangible assets as criteria for organizational performance

During the development of a business proposal, the valuation of the assets to be used in order to reach the goal of economic ally profitable production obeys a logic of "subjective" rationality, according to criteria defined by the owner the assets.

According to Martins (1972), a product can have different economic values depending upon its owners perspective of income, as determined by a structure of calculations pertaining to parallel situations. However, the sum of individual values in the assets used for pursuing the enterprise mission, hardly represents the total value of the organization. Thus, the failure to determine a total value of the organizational assets leads to the appearance of the goodwill that for Reis (2002) represents an obstacle to the managers' information, and is called "a repository of unexplained values".

Thus, it is necessary to demonstrate how the intangible assets can work as elements that let the operational efficiency emerge.

III. Organizational intangible assets and operational efficiency

In their management of production systems restrictions methodology Antunes Júnior and Lippel (1998) propose the adoption of IGOP (Index of Global Operational Profit) as an instrument of measuring efficiency in manufacturing work stations. This proposed index (initiated by Nakajima, 1998), might be obtained from the multiplication of three production indexes of production (Geremia, 2001): the availability index (operational time); the performance index (operational performance) and quality index (approved products), described in equations 1, 2 and 3, respectively:

$$\text{Availability index} = \frac{\text{load time} - \text{losses due to breakdowns and setup}}{\text{load time}} \quad (1)$$

$$\text{Performance index} = \frac{\text{quantity produced}}{\text{work time} \,.\, (\text{capacity/time working})} \quad (2)$$

$$\text{Quality index} = \frac{\text{quantity produced} - \text{quantity recycled}}{\text{quantity produced}} \quad (3)$$

The IGOP calculation is described in equation 4.

$$\text{IGOP} = \text{availability index.}\ \text{performance index.}\ \text{quality index} \quad (4)$$

The IGOP can also be calculated by the rate between the sum of production time of a certain asset (product, piece) multiplied by its quantity, divided by the total time available for transformation, as described in equation 5.

$$IGOP = \frac{\sum_{i=1}^{n} tp_i.q_i}{T} \quad (5)$$

Where:

tp_i = time of piece/product i;
q_i = quantity produced of the piece/product i;
T = total time.

For the adoption of IGOP as an instrument of measuring operational efficiency, it is assumed that the action of the manufacture unity (production, maintenance, logistic) and everything involved with quality, processes, and groups of improvement among other functions is integrated (Antunes Júnior and Lippel, 1998).

In an attempt to measure and evaluate individual performances for different organizational units, Pandolfi (2005) defends the concept of efficiency seen through valuation performance, called DEA – Data Envelopment Analysis, adapted and represented in equation 6.

$$Efficiency = \frac{\text{tangible exits}}{\text{tangible incomes}} \quad (6)$$

Pandolfi (2005) suggests that the DEA would be a way to measure the relative efficiency of a production system compared to other similar systems, those that produce quantity, even if different, of determined products and services from variable quantities and with similar kinds or raw material. Therefore, the maximum production that can be obtained from a system is less than or equal to the input, assuming that the most efficient system presents no losses, thereby reaching the maximum efficiency level of 100% (maximum efficiency = 1).

The efficiency measurement of each unit (organizational, department and/or section) can be defined as, the weighed sum of the outputs, divided by the weighed sum of the inputs of each of the n unit to be evaluated (see equation 7).

$$h_{j0} = \frac{\sum_{r=1}^{m} u_r.Y_{rj0}}{\sum_{1=1}^{s} v_i.X_{ij0}} \quad (7)$$

Where:

hj = efficiency of j unity;
ur = value attributed to the r product or service output;
Yrj = quantity of product or r service in the j unit;
vi = cost attributed to the i resource;
Xij = quantity of the *i* resource consumed in the j unit.

Thus, the first question would focus on the need for a comparable measure of efficiency, attributing an adequate set of weights to the coefficients of costs and values for the resources used. Such a question leads to the issue of how to obtain such a set of weights in order accurately assess the performance of the units.

However, it is difficult to attribute weights without knowing the production function of the system as a whole, considering its operational characteristics (inputs and outputs) and the environments where they belong (Pandolfi, 2005).

It is proposed that calculate index of operational efficiency, one can consider more than the value of the tangible assets as raw material of production. Intangible assets are also directly responsible in the creation of organizational value from the operational environment. The inputs of a production system can be represented as in equation 8.

$$\text{Tangible inputs} = f(\text{tangible assets} + \text{intangible assets}) \quad (8)$$

Tangible output is a result of the combination of tangible and intangible assets as described in equation 9.

$$\text{Tangible outputs} = f(\text{tangible assets; intangible assets}) \quad (9)$$

The concept of operational efficiency is in equation 10.

$$\text{Efficiency} = \frac{\text{tangible outputs}}{\text{inputs (tangible assets + intangible assets)}} \quad (10)$$

Considering that the outputs are represented by tangible elements or an inseparable combination of tangible and intangible elements, it is possible to calculate the levels of operational efficiency of the production units from the allocation of resources in the intangible assets, crucial to the manufacture of products considered strategic to business.

The academic world and practitioners have tried to improve the quantity and quality of the elements' contribution that brings value to the organizations. Yet, of the need is recognized to determine "how" the intangible assets would be accessed.

IV. Determination of Indicators for Intangible Assets Management

A fundamental point to consider is the determination of indicators that represents not only the incoming profits of the production activity such as: receipts, costs, profits by action and investment income.

According to Nunes and Haigh (2003), most of the performance indicators were developed in the beginning of the organized activity production together with the appearance of joint stock companies when the tangible capital represented 100% of the value of a company and was crucial to the development of the measures that could orient the performance of companies.

The financial indicators performed a valuable and unique instrument for many decades, monitoring the performance of machines and equipment used in the production and commercialization of products and even of some services, consonant with the financial income obtained from those activities.

With the exponential growth of the participation of intangible assets in conception processes, fabrication, commercialization and even final consumption of products and services, new abilities, knowledge and know-how constitute elements that cannot be guided by financial indicators (Nunes and Haigh, 2003). For França (2004), the evaluation of intangible asset indicators becomes relevant if it is possible to realize a continuous process of self-knowledge of the organizational values. Attention should be turned to the understanding of the aspects that generate value, but are not recognized by the traditional systems of measurement, in order to discover non-formalized processes in the organization.

It is worth nothing that even with the proposed mapping of the processes responsible for value creation and the establishment of performance indicators for these same processes, the existence of an elevated level of complexity included in the activities developed inside the organizations must have external support that determines and redefines the aim of the organizational actuation.

Most methods for establishing indicator establishments, based on the logic of scorecards, involve the function of the strategic choice most accepted inside the organization. The cataloguing of indicators for intangible assets used in companies with different market focus or even with distinct production activities can represent a less painful work, in order to establish indicators that translate a reality of the recognition of which intangible assets it is that can bring an effective contribution to the organizations performance (Almeida, 2003).

However, not all organizations have a sufficient and appropriate number of indicators that can be used for the orientation of actions related to the determination of internal potential intangible assets. Thus, there are alternative ways to meet this need.

There is a need to limit the numbers of organizational indicators to remove aspects that are irrelevant in the determination of the intangible assets conceived from an internal vision. Almeida (2003) defends the establishment based on organizations oriented precisely to the production of knowledge and are in initial stages of activities development. He proposes the possibility of intangible assets identification using two parameters (see Figure 1):

- probability of manifestation (PMA): the probability of an organization to detain intangible assets of a determined kind and, if detaining, the probability of being identified;

- measurement level (GM): for the kinds of intangible assets that manifest themselves in the organization (existence and identification), which is the facility of measuring them according to generic rules of scorecards.

Parameters	Level
PMA Probability of Manifestation	↗ - Elevated
	➔- Average
	↘ - Low
GM Measurement Level	↗ - Elevated
	➔ - Average
	↘ - Low

Figure 1 – Simplification for the Adapting Rating of Evaluation Methods of the Intangible Assets. (Almeida, 2003)

Although it looks very simple at first sight, the identification of intangible assets proposed by Almeida (2003) appears as a possibility for determination of internal intangible assets, which can be identified according to who chooses them, and can, after this analysis, proceed to the choice of indicators that look more adjusted to the intangible assets profile. The goodwill consists exactly of the calculation of the difference between the total value of the company and the evaluation of its tangible liquid assets and intangible individuals, whichever value is not open for allocation is considered goodwill. However, the more assets are identified, the less will be the residue of the goodwill (see Figure 2), tending to disappear when every kind of tangible and intangible asset is identified (*Congrès International de Coûts*, 2001).

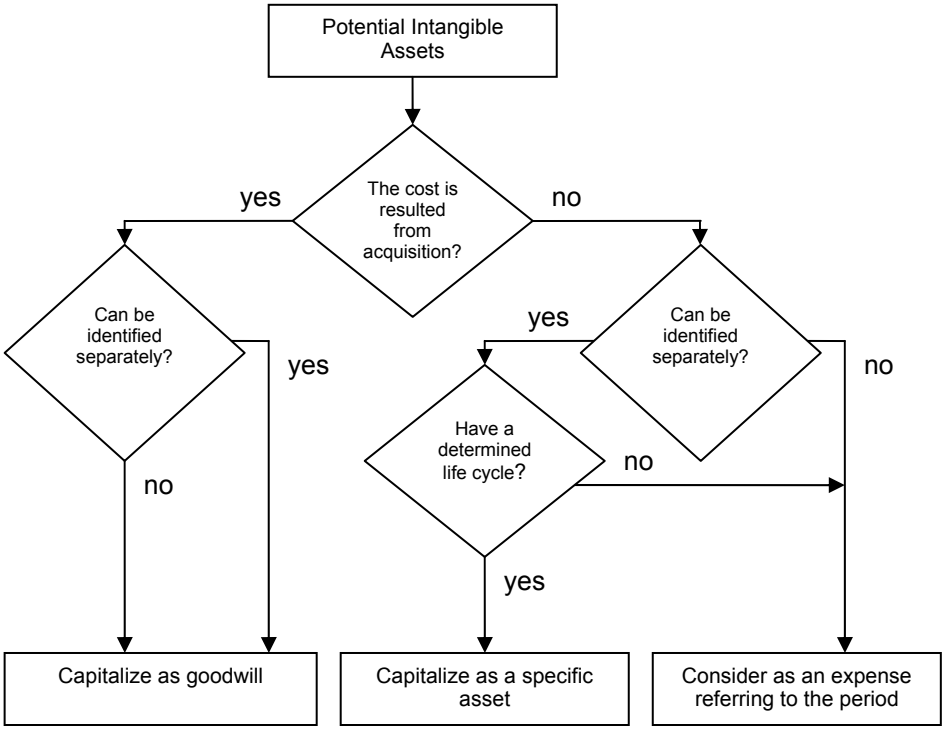

Figure 2 – Identification of Potential Intangible Assets. (Williams, Stanga and Holder, 1989)

From the analysis proposed by (Williams, Stanga and Holder, 1989), the undetermined "intangible repository", named goodwill could be classified separately from the intangible assets that represent a more significant value source to the organization.

Yet, it is observed that the subsequent expenses over the intangible assets can also be recognized with the condition of being able to generate future economic benefits, and that the expenses are measured and attributed to the respective intangible asset in a trustful way (see Figure 3).

Traditional Intangible Assets	Treated as expenses
Brands	Advertising and Promotions
Copyrights	Advancement to authors
Commercial Franchises	Costs of software developing
Sport Franchises	Costs of debt securities emissions
Softwares	Judicial costs
Goodwill	Marketing Researches
Licenses	Organization costs

Figure 3 – Demonstration of the Intangible Assets Treated as an Expense. (*Congrès International de Coûts*, 2001)

Having the possibility of a categorization of the intangible assets, the organization can direct their efforts to achieving their internal goals, supposing that these same intangible assets represent a contribution only from the moment that they bring improvement to the levels of internal efficiency to the production operations.

Below we will describe the implications of the consideration of the internal intangible assets in the calculation of the efficiency levels in the manufacturing unit.

V. Identification of Internal Intangible Assets and Calculation of the Operational Efficiency Levels

From the demonstrations of the organizational intangible assets, relationship with the production process formation, a novel management model was designed that is capable of identifying the property of internal intangible assets and that can demonstrate their contributions for the growth of the operational efficiency in the manufacture of goods and service contexts. For this, the concepts of Iudícibus (1997) and the classification of Peña and Ruiz (2002) were used for the identification of internal intangibles to the organization, distinguishing these assets from the following described procedure. These internal intangible assets are:

- those considered to be owned;
- those that provide expected generation of future benefits;
- those that are for the organization's exclusive use.

It is necessary to exclude the intangible assets developed from partnerships, in order to effectively define intangible assets pertaining to the organization. The Figure 4, in the form of a flow chart, helps to identify the interne intangibles assets of the other intangible assets.

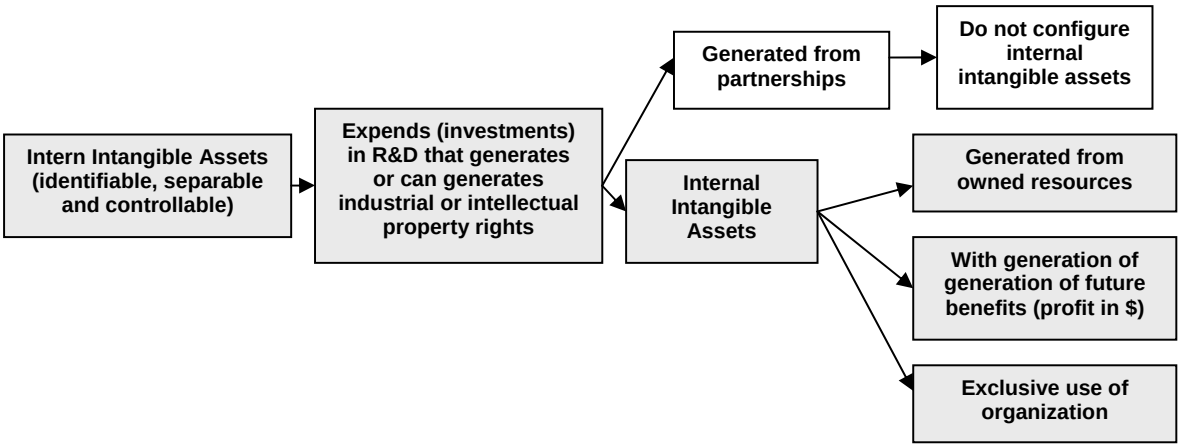

Figure 4 – Flow Chart of Determination of Internal Intangible Assets (IIAs).

From the contributions of Pandolfi (2005) for the calculation of the efficiency of a production unit (see equation 7) and from the considerations contained in equation (10) referring to the participation of intangible assets in the operational efficiency, the propertied formula for the calculation of the efficiency levels is made for each product that is considered strategic to the business context, considering the integration of internal intangible assets in each section that constitutes the manufacturing unit.

VI. Conclusion

This article aimed at demonstrating the relationship of the organizational intangible assets with production processes that can be used for the definition of which would be the internal organizational assets to the organization, considering Iudícibus, (1997) definition: "those generated in the context of the organization and originated from research and development that can effectively represent future intellectual or industrial property rights".

For the determination of the level of contribution that the intangible assets can generate, one can have in mind their probabilities of manifestation and their levels of relative importance estimated for the value generation to the organization, via the approach given by Almeida

(2003). The classification of the intangible assets of the organization's property can be given by the methodology of Peña and Ruiz (2002) supported by the considerations of Williams, Stanga and Holder (1989).

It was observed that the concept of efficiency taken from the considerations of Pandolfi (2005) should be perfectly adjusted for the consideration of the intangible assets, weight in the calculation of the manufacturing operational efficiency levels. It is concluded that for the improvement of the manufacture activity operational efficiency can be considered the participation of organizational internal intangible assets as effective elements that energize the organizational performance should be considered.

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Towards a multi-input model, method and ILM (Ideas Lifecycle Management) tool for innovation

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Abstract: This paper focuses on the early design phases of innovative projects. More precisely, the question of the innovation opportunities development and management is addressed here, starting from a theoretical model and methodology, until precise tool perspectives. The key elements of our approach are the PTC multi-input model and the C-K theory, and we provide a background on them. Our model is based on three dimensions (concept, technology and potential) and highlights the need of interactions between them regarding strategic and operational levels. Starting from the analysis of the three dimensions of the PTC model, different opportunities for the innovation are identified. In order to develop every identified opportunity, the three dimensions have to be explored with the C-K theory and two specific workshops resulting in a tree diagram. After a case study, the paper presents also tool perspectives dedicated to structure the preliminary exchanges among all stakeholders using criteria.

Keywords: Early design phases, Innovation process, PTC model, C-K theory, Design spaces.

I. Introduction

In the economical field, there are a variety of different innovation theories that have been proposed in the literature. In general, one can distinguish between two principal innovation models: the "science push" model (innovation pushed by the science), and the "demand pull" model (innovation pulled by the demand). These two models are mainly based on the two classical concepts in economy: the offer and the demand. However, they cannot be regarded separately since the offer and the demand have to be taken into account in order to understand and manage the innovation process (Mowery and Rosenberg 1979, Rothwell et al. 1988).

Early design phases have a high impact on the innovation process efficiency. The difficulties and weaknesses of the involved cooperation processes have been extensively studied (Merlo and Legardeur, 2004), especially when a new concept or a new idea is taken into consideration. During these early phases, exploring new alternatives, such as new technical concepts or technologies, is very difficult and off-putting as the actors find themselves devoid of knowledge in certain areas and tend to remain faithful to traditional solutions that are already proven to be stable and reliable.

The innovation process is a complex phenomenon that is difficult to model. In fact, in the hierarchy model (Gomory 1999) (sometimes also called "step by step" model), the innovation process is considered as a linear progression towards increasingly practical solutions. The Roozenburg and Eckels model (Roozenburg and Eckels, 1995) follows the same idea, but integrates many parallel components (production, product, and marketing). Kline and Rosenberg consider the innovation as a central chain of design with iterative feedback loops that is interconnected with the knowledge sphere (Kline and Rosenberg, 1986).

In this paper, we propose a model to support innovation in early design phases combined with a methodological approach. This paper is organized as follows. In Section 2, we provide a background on the PTC multi-input model and the C-K theory since they are the key elements of our approach. In Section 3, we show how to exploit the PTC model for innovation by dividing its three dimensions into design spaces. Section 4 shows how to use our approach at the

example of the innovation process of a heated surfing wetsuit. In Conclusion, we present tool perspectives with respect to mobilized criteria in innovative design process.

II. Background on the PTC multi-input model and the C6K theory

2.1 The PTC multi-input model that supports innovation in early design phases

In 2006, we proposed the PTC multi-input model (potential technology concept multi-input model) for the early phases of innovation processes (Pialot 2006). Our model integrates both the technological dimension and the market dimension via the potential. The PTC model is illustrated in Figure 1. The particular characteristic of the PTC model is the association of a concept to a potential of added value and one or more technologies. Its main objective is the synthesis and confrontation of the data coming from the technological survey, the market survey, and the different concepts of solution coming from the idea's portfolio of the company.

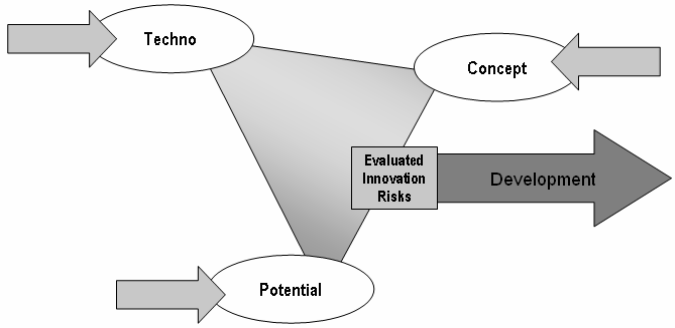

Figure 1. "Potential-Technology-Concept" model (Pialot 2006)

In the following, we define the three dimensions of the PTC model. The **potential of added** value dimension models the existing gap between the product and the current or future customer expectation. The potential should take into account not only the approaches concerning the analysis of the customer's need, but also its change dimension. Therefore, the clear identification of the product added value induced by the potential is not only integrated in the analysis of the current need, but also in the analysis of the changes (e.g. usage, way of life). The **technology** dimension encompasses the technologies (e.g. material, physical principle) and the production techniques for the new product development. The aim is to identify the opportunities offered by the technology (e.g. mechanical, electronic, magnetic…) that can open the domain of "the possible". The **concept** dimension is related to the different ideas of the new concept of solution issued from any creativity method, from a tools or ideas box, and from the portfolio of the company.

The PTC model proposes a flexible methodology for the exploration of innovation opportunities based on multiple inputs: the potential of added value identification, the technological opportunities emergence, and the innovative concept generation or collection. For example, every stakeholder in the company can identify a problem or a change (potential dimension), identify the use of another material or a different process (technology dimension) or have a new idea of solution (concept dimension).

In the PTC model, the three dimensions are linked and aim to foster the networking between them. In fact, every new input proposition is analysed regarding the three dimensions of the model (Figure 1). This approach provides a framework for a first evaluation of innovative opportunities and allows the limitation of the risks related to a future innovation (in order to understand the risks related to innovation, see (Halman et al. 2001)).

2.2 The C-K theory for a conceptual exploration and development of the solution space

The C-K theory, initially proposed by Hatchuel in 1996 (Hatchuel 1996), is named “C-K theory” because its central proposition is a formal distinction between concepts (C) and knowledge (K). The starting point is an interpretable concept without any logical status, or, in other words, a comprehensible idea that cannot be directly materialized. For a better understanding, consider “Keys that cannot get lost” as an example. The principle of the C-K theory is to progressively add properties to the concept by switching between the concept space and the knowledge space. Adding the properties supplies an interpretable “object” that can be materialized by a stakeholder. The resulting tree diagram of the development of the initial concept highlights the exploratory character of the C-K theory. Some branches of the tree are cancelled, others further developed. This formalism supports the exploration by a conscious and progressive development of the different solution concepts starting from the initial concept. For further details on the C-K theory, we refer the reader to (Le Masson et al. 2006).

III. From the PTC model to a methodological approach to innovate

Starting from the analysis of the three dimensions of the PTC model (potential, technology, concept), different opportunities for the innovation are identified. In order to develop every identified opportunity, each dimension has to be explored in order to confront the point of views, and thus to innovate. However, the three dimensions of the PTC model cannot be considered in the same way regarding the role of Innovation in RID organization defined by Hatchuel (Le Masson et al. 2006):

1. The potential of added value and the technology can be evaluated for future innovation. On the other hand, a concept cannot be evaluated since, beforehand, a concept is neither good nor bad when the relationship to the potential of added value and to the technology in the innovation is ignored. When developing the concept to one or more solutions, the dimensions potential of added value and technology have to be explored and confronted to the dimension of the concept.

2. The concept dimension has to be explored (transversal process) and developed (vertical process). Indeed, it is necessary to pass from an abstract concept to one or more solutions.

Concerning the exploration of the concept dimension, we propose to use the C-K theory: a reasoning about an innovative conception is done by starting from the initial concept and exchanging between the concept space and the knowledge space. During the reasoning, Hatchuel et al. propose to use design spaces. A design space is a limited working context that allows learning within the design process. This restriction of the reasoning, or, in other words, localized workshop, is realized for a particular issue and the conclusions are then reintegrated in the principal reasoning.

Complementary to this reasoning about an innovative conception relative to the concept dimension, we propose to explore the two other dimensions of the PTC multi-input model, i.e. potential and technology, by opening for each dimension a specific workshop. The workshops related to the potential and technology are used throughout the entire design process and “feed” the principal reasoning continuously. Figure 2 illustrates how these two particular workshops refer to the principal reasoning that is itself related to the concept dimension.

A limitation of the C-K theory is that the innovation must be concept driven. In our multi-input approach, the innovation can also be technology driven or potential driven. Indeed, innovation opportunities are based on multiple inputs: the potential of added value identification, the technological opportunities emergence, and the innovative concept generation or collection. Each of these three workshops allows all the stakeholders to work in the way they are used to, while being the most inspired. For example, ergonomist and marketing people are used to work in the design space potential – they are concerned by the demand and the usage of the clients, and they are especially interested by the added values. The existence of the three workshops

throughout the entire process enforces the continuous exploitation of all the three dimensions. We are convinced that this is a prerequisite for innovation. Consequently, the obtained knowledge and information is rich and accurate in order to better orientate the choices in the early design phases of the innovation process.

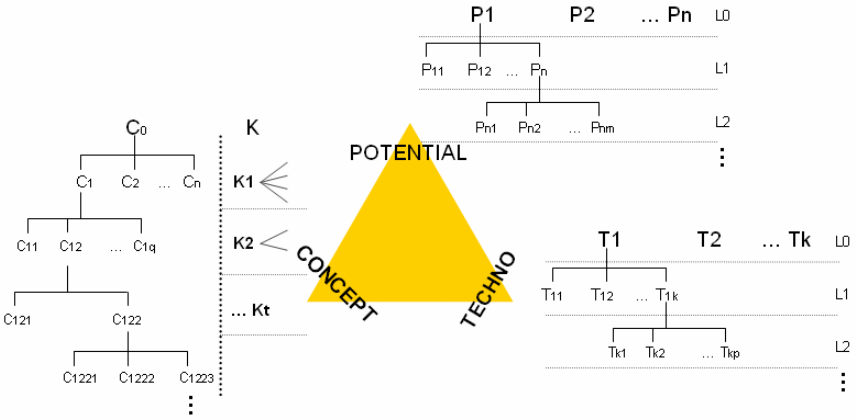

Figure 2. C-K reasoning related to the concept dimension and the design spaces related to the potential and technology dimensions.

IV. Application to a case study

The theoretical results have been tested on different examples, and we present here a student's case study of the imagination of a "heated surfing wetsuit". In the workshop of the *potential* of added value for the client, we started by the identification of various categories of clients that could be potentially interested in the heated surfing wetsuit. For each potential client, the usage value has been analyzed by exploring the different situations that are involved in the given sport. The case study has been temporarily restricted to the design space on diving wetsuits that have been studied extensively in order to understand the thermal behaviour. The result of this study allows the identification of the design criteria of the wetsuits. For the *technology* dimension, a flowchart of the potential technologies has been first created. The aim was to analyze if an existing technology could be used, and to discuss the advantages and drawbacks of every technology. Then, an expert group familiar with the textile industry has been consulted in order to gain the most precise insight about the future of these materials. Finally, more locally, a design space on the physical contradiction between the thickness of a material and its thermal isolation has been studied by using some principles of the TRIZ method (Altshuller 1999). In the concept dimension, some different elements have been modelled: the surfing, the role of a wetsuit, and the heat notion. These different modellings have brought up several questions and various problems, and several design spaces have been created. As a consequence, we acquired a lot of knowledge and many criteria have been identified. All theses different explorations on the three dimensions allowed us to advance the reasoning about an innovative conception, and a synthesis in the form of a C-K tree structure can be seen in Figure 3.

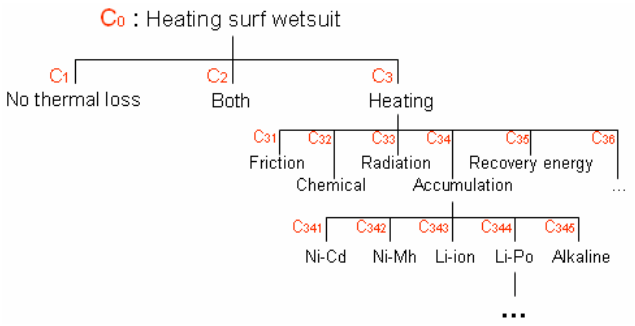

Figure 3. Reasoning in the form of a C-K structure

V. Conclusion

New product/process ideas are thus developed during periods of negotiation and research of solution, which are often informal and unpredictable. At this level the goal of these phases is first of all to be able to bring together a certain amount of data and information in order to justify and consolidate the idea while creating a configuration in which it is possible to launch an innovative project. The PTC (Potential –Technology – Concept) approach is one way to structure this complex process of emergence of a new innovative solution.

The explorations on the three dimensions allowed us to identify several criteria for the choice of the innovation. To exploit these results, we propose to use and develop in the future the ID² software tool proposed by Legardeur (Legardeur et al. 2005). ID² is mainly oriented towards the synthesis and the sharing of information about new proposed concepts and provides a support developing new ideas by proposing a platform for negotiation. The multidisciplinary team enriches each concept with its knowledge and criteria (Garro et al. 1998). ID² uses a collaborative platform around a concept-criteria table: the different concepts that should be compared are spread along the columns, and the criteria along the lines of the table. At the end, the aim is to track back the mobilized criteria that lead to the definition of the chosen concept.

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An empirical model of resource-based view on entrepreneurship and innovation

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Abstract: This research study develops an empirical model to identify four critical entrepreneurial and innovation resources, spanning from opportunity recognition to organising these resources and creating heterogeneous outputs that result in superior firm performance and value to the market. The research result supports empirically the resource-based view, the entrepreneurship and innovation theories.

Keywords: Entrepreneurship; innovation; resource-based; dynamic capabilities; empirical

I. Introduction

The term entrepreneurship and innovation are used inter-changeably (Drucker 1985). Among different types of entrepreneurship, corporate entrepreneurship research domain is most adjacent to the innovation research domain. Though a number of frameworks have been proposed over the last two decades, as summarised in table 1, few empirical studies emerge to test rigorously their validity. Cornelius et al (2006) conclude that for the entrepreneurship research field to advance forward, more empirical research is needed for understanding of the entrepreneurship phenomenon. Furthermore, both the entrepreneurship and innovation research domains draw heavily from the strategic management research domain (Pearce 2003), where resource-based view (RBV) is a dominant theory. Motivated by the lack of empirical research and generally accepted framework in the entrepreneurship, innovation, and RBV research fields, this research study aims at constructing empirically an integrated RBV model that capture all the key factors proposed in previous research to explain the corporate entrepreneurship and innovation phenomenon.

II. Corporate entrepreneurship model

Entrepreneurship and innovation is part of resource-based view (Rumelt 1987). Corporate entrepreneurs discover opportunities, acquire, develop and combine desirable resources and knowledge by deploying its external environment scanning and internal development capabilities. Hayek (1945) stressed the importance of learning and knowledge in this entrepreneurial process. In this process, all those factors that are listed in table 1 are contributing to competitive advantage and firm performance.

Research study	EK	SV/SF	MO	EO	DC	FP
(Guth & Ginsberg 1990)	*	*				*
(Cohen & Levinthal 1990)	*				*	
(Covin & Slevin 1991)	*	*				*
(Hornsby et al. 1993)		*		*	*	*
(Morris et al. 1994)	*	*		*		*
(Lumpkin & Dess 1996)	*			*	*	*
(Barrett & Weinstein 1997)		*	*		*	*
(Hisrich & Peters 2002)	*	*		*	*	*
(Morris & Kuratko 2002)		*		*		*
(Dess et al. 2003)	*				*	

Table 1: Corporate entrepreneurship models and frameworks

EK: External knowledge
SV/SV: Shared vision and strategic fit
MO: Market orientation
EO: Entrepreneurial orientation
DC: Dynamic capabilities (individualism and collectivism)
FP: Firm performance as outcome or dependent variable

Each individual factor will be discussed below, through the lens of RBV and its extended dynamic capabilities (DC) approach.

1. External knowledge

The environment is a source of opportunity and resources. Entrepreneurial and innovative firms proactively scan and evaluate information about market trends and entrepreneurial opportunities, and technological innovation throughout different stages of the organisational life cycle (Koberg et al. 1996). This purposeful organised search for changes and systematic analysis of the opportunities is the first stage of systematic innovation (Drucker 1985). Entrepreneurs act upon their beliefs to exploit and explore the opportunities (Kirzner 1979). This recognition process results in new and profitable discoveries, inventions, and economic rent. (Alvarez & Barney 2001).

2. Shared vision and strategic fit

Rockey (1986) argued that vision of success generated the needed energy and motivation among successful entrepreneurs. Apart from the shared vision, other entrepreneurial capabilities include strategy formulation, risk and return assessment, action planning, desire to achieve with own and joint efforts, taking initiative and responsibility of implementation. The pursuit of strategic fit serves as lens to scan environment. Barney (1986b) argued that analysis of internal skills and capabilities provides more accurate information about the potential value of strategic resources for implementing a strategy than environmental analysis. Different entrepreneurs have different judgements about the future value of a strategic resource. Their heterogeneous judgements result in different resources picking, acquisition and development to deliver valuable heterogeneous outcomes.

3. Market orientation

One of the critiques raised by Priem and Butler (2001) against the resource-based view is the absence of demand heterogeneity. In response, the authors introduce a market orientation factor into the model. From the resource-based view, successful business model always links market needs and company resources (Ardichvili et al. 2003) in a way that best achieves its strategic objectives. Market orientation requires capabilities in 1) market focus to detect critical market trends and issues to attract and retain customers by developing innovative technologies that have applications in variety of industries (Day 1994); 2) close contact and engagement with customers to deepen relationship and understanding of their needs and requirements as inputs for entrepreneurial and innovative activities. This intangible resource is hard to imitate (Srivastava et al. 2001).

4. Dynamic capabilities

Insufficient understanding of dynamic capabilities has been a persistent research problem in the resource-based view domain. Eisenhardt and Martin (2000) propose that dynamic capabilities exhibit common features of best practices that can be observed among effective processes across firms. Cross-functional team, open communication and feedback are examples of these commonalities. Dynamic capabilities also have the following characteristics (Barney 1986a; Dierickx & Cool 1989): 1) Long period of time to develop and maintain; 2) Intangible and non-tradable assets; 3) Internally developed, integrated and accumulated; 4) Continuous investment to maintain and upgrade; 5) Require supportive organisational culture to nurture. They are tacit,

heterogeneous and inimitable, socially complex resources that are embedded into organisational and social settings, and source of sustainable competitive advantage. In this model, dynamic capabilities are divided into two factors - individualism and collectivism. They represent the flows of capabilities that are generated over time to support the firm to adapt to changes in market, technologies, and competitive moves. These flows are then accumulated and integrated into existing stock of capabilities. Flows and stock of capabilities are socially embedded into these two factors.

Individualism

Entrepreneurship does not happen without entrepreneurs. Past research studies centers on personal traits of entrepreneurs (Gartner 1990). Founder entrepreneurs, such as Edison, Ford, Jobs, Gate, and Dell, are highly individualistic. They have the “big idea” or technology (Reich 1987) to create new combinations that cause discontinuous change and disturb market and industry equilibrium (Cheah 1990). However, the essential ingredient is the excess capacity or unused resources as major driver of growth and expansion (Penrose 1959). It influences the scope and direction of search for, experiment, and recombine knowledge in entrepreneurial and innovative activities. Established entrepreneurial firm offers corporate entrepreneurs resources that are critical for concept development, testing, and implementation (Mahoney 1995).

Collectivism

Team is the essential ingredient of corporate entrepreneurship (Stewart 1989) and growth (Penrose 1959). Multi-functional teamwork and learning are vital for entrepreneurial success in response to the complexity and uncertainty of entrepreneurial and innovative activities such as new product development, Within a cross-functional team, corporate entrepreneur or intrapreneur acts as team champion, facilitator or project “cheerleader” (Souder 1987). When accompanied with diversity and openness, team learning is a valuable creative problem solving and knowledge generation capability that is heterogeneous, difficult to transfer and imitate, and satisfy the social complexity and causal ambiguity conditions, and a source of sustainable competitive advantage (Barney 1991).

5. Entrepreneurial orientation (EO)

Miller (1983) offered the first synthesis of earlier research studies to identify innovativeness, risk taking and proactiveness as the three major attributes of entrepreneurs and entrepreneurial firms. There is a consensus among entrepreneurship research studies to confirm this observation (Lumpkin & Dess 1996). Innovativeness is reflected by development of novel or unique products, services or processes. Risk-taking is the willingness to pursue opportunities with a reasonable probability of failure. And proactiveness means possessing the ability of persistence and creative problem solving in overcoming obstacles.

III. Model construction and empirical results

Multiple linear regression was selected to construct the relationship between the proxy of entrepreneurial and innovation performance and six explanatory factors. Initially, only three factors (external knowledge, entrepreneurial orientation, collectivism) were regressed against the proxy variable of entrepreneurial and innovation performance (financial performance in new product development). As shown in table 2, all these three factors exhibit statistical significance. The adjusted R square is 0.85, indicating that 85% of the variations of entrepreneurial and innovation performance can be explained by variations of these three explanatory factors.

However, when the variables shared vision/strategic fit and market orientation are introduced into the regression equation, external knowledge drops its statistical significance. Also, when the variable individualism is introduced, entrepreneurial orientation drops its statistical significance as well. As shown in table 3, all the new set of four explanatory factors exhibit statistical significance. The new adjusted R square is improved to 0.92.

Table 2: Regression result with external knowledge and entrepreneurial orientation

Independent Variables	Coefficients	p statistics
External knowledge	0.35	0.00
Entrepreneurial orientation	0.29	0.00
Collectivism	0.33	0.00

Table 3: Regression result with external knowledge and entrepreneurial orientation displaced

Independent Variables	Coefficients	p statistics
Shared vision and strategic fit	0.25	0.00
Market orientation	0.25	0.00
Individualism	0.23	0.00
Collectivism	0.22	0.01

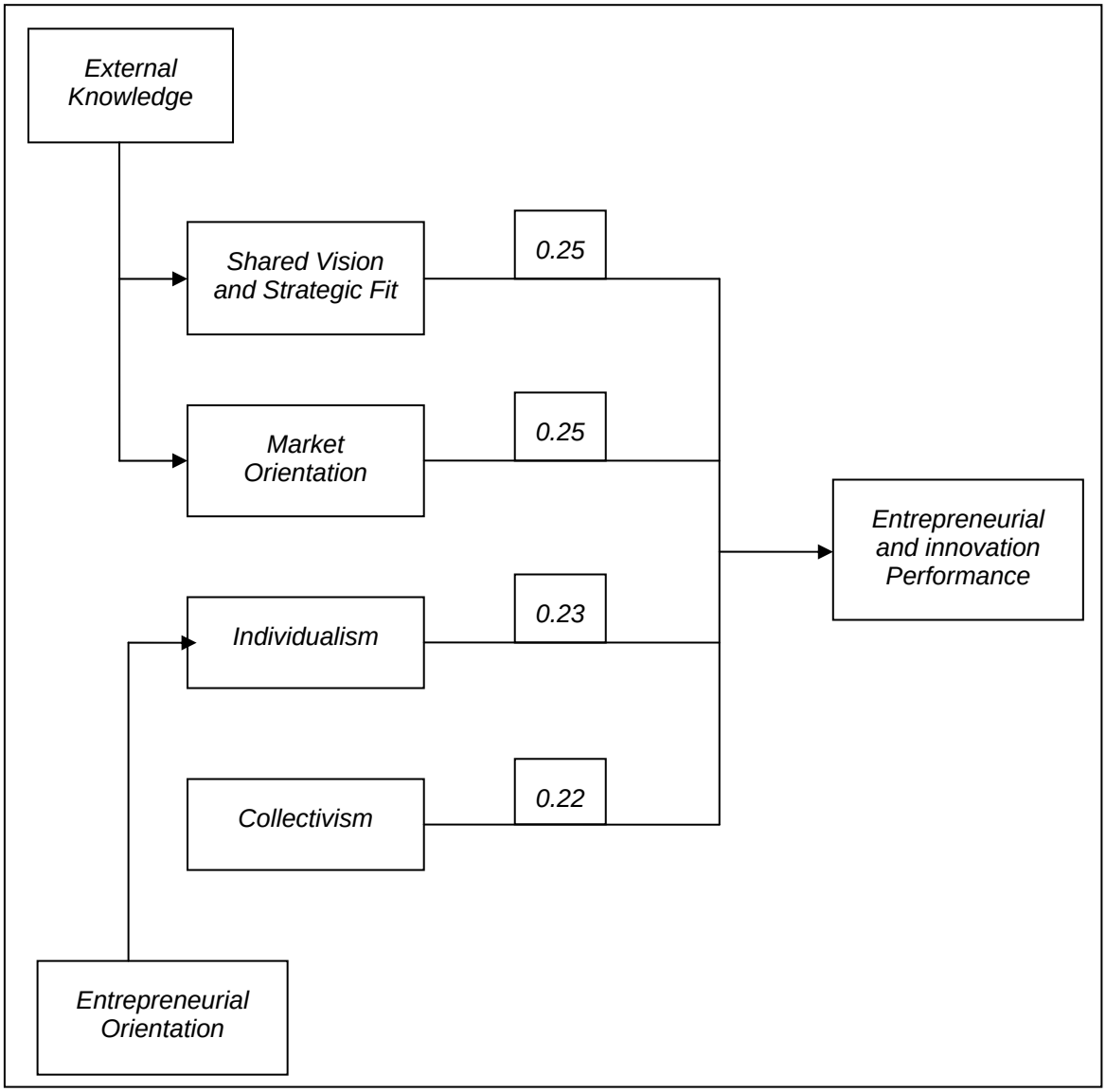

Figure 1: Corporate entrepreneurship model, with estimated regression coefficients

As shown in figure 1, the regression results indicate the indirect influences of external knowledge and entrepreneurial orientation on entrepreneurial and innovation performance, mediated by shared vision/strategic fit and market orientation, and individualism respectively. This does not mean that external knowledge and entrepreneurial orientation are redundant. It highlights the causal chain that external knowledge has to provide relevant knowledge for market/product strategy formulation in order to contribute to entrepreneurial and innovation performance. And entrepreneurial orientation has to focus on making use of the time and resources for experimentation, entrepreneurial and innovative activities.

IV. Conclusion

This model integrates and supports the previously proposed corporate entrepreneurship theory and frameworks. Contrary to the mainstream assertion, entrepreneurial orientation cannot sufficiently guarantee high firm performance by itself. It needs to accompany with other critical success factors, as identified in this research study. This model also provides empirical evidence to support resource-based view and its extended dynamic capabilities approach. It identifies the six input measures, and reveals the causal chain that entrepreneurial and innovative resources and capabilities be deployed and recombined to create, improve and sustain competitive advantage and firm performance. Many firms try to imitate but fail due to lack of understanding of this causal mechanism, compatible supporting culture and right methods to implement.

Acknowledgement

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Boundaries Lab

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Abstract: Expansive learning considers a new way of acquiring knowledge regarding organisational reality, where tacit knowledge is shared in a process of socialisation, creating common meanings and enabling the transformation of the hegemony of mechanicist productivity and quality towards an innovative organisation where knowledge is the key.

Standing the organisation face-to-face with its boundaries creates new spaces for the exchange and creation of knowledge. It enables learning and the acquisition of new knowledge, and questions the hegemony that supports the existing paradigm. The activities developed when faced with its boundaries are always double-flow interactions and to be expansive, the actions developed by an organisation must imply a change in its existing behaviour and practices.

Keywords: tacit knowledge, organisational learning, complexity, organisational boundaries, learning spaces

I. The organisation and its limits.

The boundaries an organisation sets for itself are based on its internal relations, culture, history, alliances, the networks in which it interacts, routines and control (Elfring and Volberda, 2002). The school of boundaries attempts to respond to two fundamental questions: Where does an organization trace out its boundaries? And, how should it manage the divisions? The analysis and design of the boundaries fit in with the objective of creating competitive advantages as proposed by the school of resources. From this point of view, the company may see itself as a set of activities, where the organisation of the transactions between the activities is its main concern. Strategy is a decision about its boundaries. Based on said boundaries, policies are defined: to make or buy, alliances, selecting suppliers, developing new products, spin-offs… the boundaries are established by both external forces and internal culture, as well as the organisation's historic position.

Therefore, confronting the organisation (the people) with its boundaries makes it possible to begin a process of expansive learning.

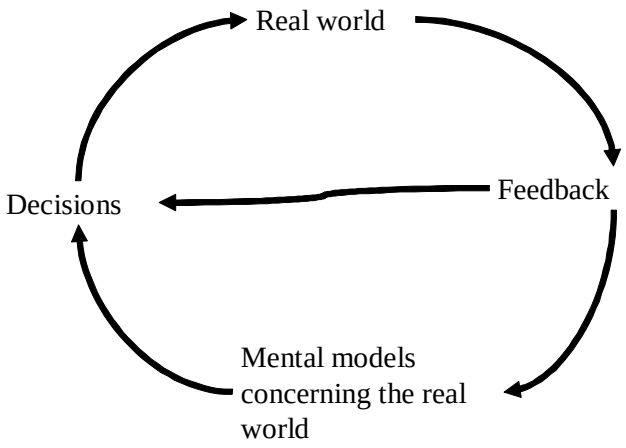
Small-scale expansive cycles provoke large expansive waves that change organisation. Any type of learning leads to a greater or smaller modification of a company's concepts, strategies, processes and products.

Forrester (1971) proposes experimentation in laboratories. The main experimental tool in laboratories is a simulative model built on the basis of systems dynamics. Forrester's argument begins by characterising certain boundaries to the "natural" organisational learning process that makes it inefficient. As a solution, he proposes the constitution of a "designed" process of organisational learning developed in the laboratory. Systems dynamics is the methodology used to design the laboratory and its instruments and also for the simulated experiment. To a certain extent, this "designed" process must be superior to the inefficiency of its "natural" counterpart and in this way, learning in the organisation should become more efficient.

Basing ourselves on Forrester's arguments, we propose the Boundaries Lab, which is a laboratory for innovation regarding limitations. Starting with the principles of system dynamics, this laboratory responds to the following concepts:

Forrester characterised the "natural" learning process as the progressive constitution of a capacity for reasoning as a result of decision and action experiences in organisational situations. In turn, this capacity for reasoning acts as a guide for the decisions and action in future situations. Consequently, "natural" organisational learning is a cyclical process (Sterman 1993; Argyris and Schön 1978).

Figura 1: "Natural" organisational learning



In the diagram, the internal cycle represents superficial trial-and-error learning around specific objectives:

"The [internal] cycle is a typical cycle of negative feedback where those who take decisions compare qualitative and quantitative information about the status of the real world with regard to certain objectives. They perceive differences between the desired status and reality and take actions which, they think, will make the real world move towards the desired status" (Sterman 1994).

However, this vision of organisational learning as one single feedback cycle is incomplete in that it fails to present the way in which it constitutes and modifies the capacity of reasoning required for taking a decision. This capacity refers to the *mental models*. Mental models are the assumptions, generalisations and also images that influence our way of understanding the world and the way in which we act. The discipline that works with mental models begins by looking at our interior to learn how to dig up our images of the world, bring them to the surface and scrutinise them to the full (Senge 1992).

This first step is aimed at opening up towards the understanding of other ways of focusing and understanding the situations that may differ from our own, attempting to integrate and understand said perceptions.

Relations are established between individuals, and interaction (negotiation) occurs through language in a certain context (ruling paradigm).

Under natural learning conditions, these mental models remain implicit. The individual is not aware of his/her own mental models. The mental model concept can be generalised for a collective group of people. In this case, the mental model symbolises the notions that are shared by the collective regarding interests and causality; this is when we are speaking of culture.

The organisational learning diagram is then completed with the external feedback cycle. This considers the explicit recognition by the members of the organisation of the mental models that condition their perception and action. As said recognition is achieved, a second-level of learning can be accessed. This learning modifies the mental models, i.e. the capacity for reasoning.

The complex nature of organisational phenomena and natural human limitations restrict this in-depth double-cycle learning. Sterman suggests, among others, the following boundaries of organisational learning:

- The dynamic complexity of organisations and consequently the impossibility of obtaining precise information about the status of the system.
- The use of confusing and ambiguous variables in the decision-taking process.
- The deficient ability to reason.
- The difficulties inherent to collective work.
- The faults in the execution and incorrect perception of feedback.

In short, "natural" organisational learning is a double-cycle feedback process which uses mental models as a starting point and, at the same time, as its main output. Its efficiency is limited by certain conditions inherent to organisational reality and human nature regarding decision-taking. In other words, intuition and culture.

To enable an expansive organisational learning process, the proposed "laboratory" tries to create an organisational reality ***model*** on which the changes in an active experimentation process can be made. In other words, in a similar way to the "natural" learning that takes place in the organisation, expansive learning occurs around an organisational model called micro-world (Papert 1980) or virtual world (Schön 1983). In our focus, this is none other than that which is created by the people who interact with the boundaries in the laboratory and we base ourselves on the fact that the world is interpreted by each individual in accord with his or her mental model (Senge 1992) and is as real as any other.

Within the interpreted world, it should be possible to experiment with decision-taking and then receive feedback on its consequences. Consequently, it should be a model that simulates the ***dynamic*** behaviour of the organisation with regard to different action alternatives and in different organisational and environmental scenarios. For said purpose, the model must consider the possible effects the decisions generate about some elements of the organisation and the consequent chain reaction affecting the system as a whole. A model satisfies the proposed requirements. This explains why systems dynamics is the appropriate methodology for the creation of the expansive learning laboratory in the organisation.

II. Exploiting knowledge through expansive learning

Based on these systemic-dynamic proposals, efficient organisational learning would be that which first of all fulfils the main objective of making explicit and modifying individual and collective mental models, which happens slowly in natural situations and normally requires a generational change. Consequently, it then allows the fulfilment of this objective faster, by overcoming the aforementioned natural obstacles that are inherent to organisational reality. These two conditions must be met to sustain that when expansive learning is coupled with the natural process, the result is an increase in the efficiency of organisational learning.

The second condition implies a confrontation with the complexities and boundaries inherent to the real organisational situation. This difficulty is apparent during the construction of the model and for this reason, the model can only be a simplified representation of said reality. Consequently, a systemic-dynamic model implies a "mathematical" formalisation of the phenomenon. In this model, the object of the learning and experimentation in the laboratory is simplified organisation. Regarding simplified organisation, we have information about its structure, shown in the systems dynamic model, and its behaviour, thanks to the possibility of a simulation. The complexity and ambiguity of the world have been interpreted and restricted in the simplified organisational model. Consequently, in the laboratory, the model satisfies the second condition for efficient organisational learning: it overcomes the obstacles of the complexity that is inherent to the world.

However, s/he who experiments with the model has no guarantee of being able to recognise and change the mental model.- Experimentation for its own sake corresponds to the internal cycle of superficial learning. The simple simulation of the model could lead to a new trial-and-error learning process.

How can learning around mental models be reached? In other words, how can expansive learning meet the first condition for efficient organisational learning? To recognise explicitly the mental models and be able to improve them, participation in the construction of the model is necessary. Building the model requires the formal definition of the undefined cases of the mental model, in particular those which refer to causality in the system. The preparation of the causal diagram and the diagram of the levels and flows typical of systems dynamics around the organisational situation represents a learning exercise concerned not only with reality, structure and dynamics, but also with the beliefs as to how said reality functions. These beliefs condition the interpretation of the situation and, consequently, determine the decisions to be taken.

As a result, for efficient organisational learning, experimenting with an already created simplified model is not sufficient; participation in its creation is necessary. Put another way, the micro-world should be used as a “transparent box” and not as a “black box” (Machuca et al 1993). The people that make up the organisation must be involved in the construction process of the model. The activity of formalising the causal structure of the situation and the debate between different individual mental models leads to making said mental models explicit and to modifying them individually.

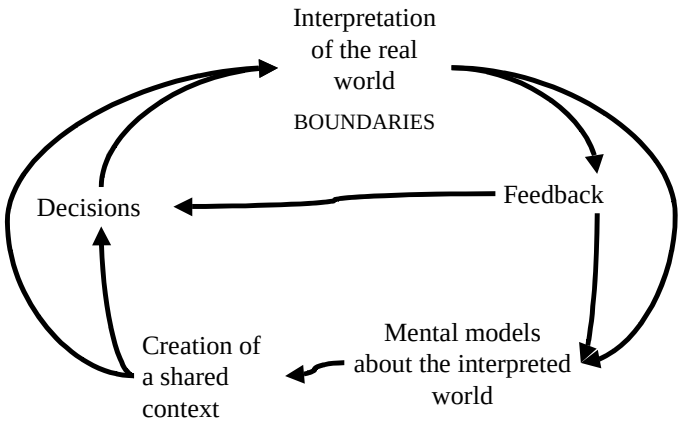
This fact makes it possible to explain the emphasis on *team learning* made by Senge (1992) in the proposals regarding five disciplines for the constitution of intelligent organisations.

In this way, expansive organisational learning understood as the collective construction/experimentation of its own interpretation of the world as part of the construction of a common understanding of the limits that determine the organisation, and therefore its very nature (in that it conditions decision-taking), increases the efficiency of learning in the organisation.

III. Expansive organisational learning

In order to overcome or lessen the boundaries of the “natural” organisational learning process, we suggest a designed process based on Forrester’s proposal. This learning process is made up of a triple feedback cycle (figure 3), but, unlike the “natural” process, although it is developed within the reality of the organisation, it occurs in the laboratory. In other words, it takes place in an atmosphere of measured action based on the identification of boundaries, as a basis for overcoming them in a process of expansive learning.

Figura 2: Expansive organisational learning



Expansive learning: a new way of understanding organisational learning

1. To question existing practices regarding boundaries.
2. To analyse existing practices regarding boundaries.
3. To collaborate and work in a team to construct new models, concepts, systems or patterns of behaviour regarding boundaries.
4. To examine and discuss the new models, concepts, etc.
5. To emulate and take on new ideas.
6. To negotiate the resources required for developing new ideas.
7. To show and modify the processes affected by boundaries.
8. To consolidate the results.

Confronting the organisation with its boundaries enables a group of people involved in a process of interaction, exchange and creation of new knowledge to interpret their own organisational reality.

For this, in the Boundaries Lab, work is carried out in a team using different tools and teamwork techniques that make it possible to design the model for active experimentation. The innovation of this proposal lies in the fact that the expansive learning process focuses on the construction process of the model, confronting people with their boundaries and revealing the way they interpret reality, As well as their mental model and the collective model. Furthermore, it creates a common understanding of organisational reality and decision-taking mechanisms, which implies that we have managed to generate an expansive learning process.

Boundaries lab

The teamwork scopes we propose belong to both context and to individual and collective realities:

- Experience: inertia, resistance to change.
- Procedures. action standards, efforts for agreeing a form of action.
- Strategy: Preset objectives, action mechanisms and control systems.
- Knowledge: what we know and know how to do well.
- Sector conditions: conditions of the area in which we move at present.
- Physical systems: Production means and technology.
- Finance: financial availability.
- People: personal uncertainties, fears, mental models.
- Culture: ruling organisational paradigm.
- Essential competences: the keys to our current competitiveness.

1. Experience

What is “familiar” against what is as yet “unknown”. It is important to understand that knowledge is an objective and that the repetition of activities holds the key to productivity and existence. It is not being aware of the fact that in reality we never do things the same way. It is important to look back and understand that nothing is the same, that although we pass by the same place again, we do so in a different way; we are not the same.

Confronting the organisation (the people) with past activities; learning that what helped us to be competitive yesterday is different today and that tomorrow we will need new knowledge to deal with future challenges.

We are not what we have done but what we are capable of doing.

Regression: It is necessary to do an exercise in which people that make up the organisation reflect collectively and confront the reality of the successes and failures of the past, what they think they have done well and, as part of an exercise of reasoning, try to establish the future value of the organisational practice.

2. Procedures

The hegemony of quality, the attempt to establish standards for the development of the activity, establishes boundaries from the moment when one way of developing the activity is adopted as the best way. Understanding that there is only one possible way of doing things well; the established way.

Benchmarking: To make the procedures explicit, consider and compare them to other practices that may make it possible to obtain the same results.

Understand the foundations for the procedures and standards, share the criteria used and realise the reason why they were established and the objective they sought. To be aware of the fact that the objectives and requirements are dynamic, the procedure defined to obtain a result today may be of no use tomorrow. To be aware that they are relative, since nothing can be established as absolute.

On the other hand, procedures and standards make it possible for us to establish consensuses and standards that make us capable of understanding each other. They are useful for supporting a paradigm and a hegemonic state as long as they try to distinguish good from bad, those that are on the inside from those on the outside.

3. Strategy

To share the vision of the organisation, its mission and the common objectives to with the organisation must respond; breaking down personal barriers.

To analyse strategy from the point of view of opportunity, what it allows to be done and undone, to limit the organisation's playing board, to vision how strategy can help the co-evolution of the organisation with its environment.

Retrospective vision: To carry out an exercise of analysis of what we predicted and what happened in reality, of the influence we have on the world's future.

To learn from the past to be capable of making it relative, of understanding objectives as dynamic objects, beings that are transformed in accord with the surrounding circumstances.

4. Knowledge

The ontology of knowledge (Fdez. Isoird 2003) establishes new philosophical principles regarding the way of understanding the relationship between the human being and the world.

- We interpret human beings as possessors of knowledge.
- We interpret knowledge as content and act at the same time.
- We interpret that human beings are developed through the way in which they interpret the world, creating themselves as part of a constant learning process.

If we start from these principles, we must think that as an organisation, it will be difficult for us to maintain anything stable, since everything varies in accord with the observer in question, and said observer learns each time s/he interacts with the environment. Knowledge is therefore not static; it is constructed at each moment.

People, who, as a whole, constitute the company, change the way in which they interpret reality at each moment. Therefore, the organisation as a sum of people also varies exponentially if we manage to get people to share their knowledge.

From the organisational learning point of view, people learn in their interaction with the environment using all their senses, including the sixth sense, intuition, the perception that something may not be what it seems, imagination and creativity.

To consider knowledge as something tangible and possessed is a boundary in itself, since it makes us believe that knowledge is a first-level asset that can be bought and sold. However, as it is inherent to people, this is impossible, since its use depends exclusively on their will to give it to the organisation through their decisions, sharing it and applying it to products, services and processes.

5. Sector conditions

The sector in which the activity of each organisation is developed conditions development and learning opportunities. It identifies the limits of the sector, analysing the conditions necessary for introducing changes as they may infer modifications to the established paradigms through the introduction of new ways of understanding the creation of value.

Our interpretation of the sector is based on our experience and, as it is the result of our knowledge, on many occasions we speak for the sector from our interpretations as individuals. This is a way of conditioning reality or creating our own.

Prospective: To see the future and the evolution of the sector with our senses and those of others, to share and create new scenarios, to analyse what is and what is not possible, what we can and cannot do.

6. Physical systems

What are our production means? What, how and when can we create value? We all have the same perception of our production capacities.

What technologies do we dominate? What are we capable of doing? What technologies are accessible?

Making an analysis of our production and technological capacities, breaking the boundaries of our organisation and thinking of the company as a network of relations means breaking the physical boundaries of the organisation and adding our capacities to those of our competitors and collaborators.

7. Finance

The investment capacity of the organisation as a whole, valuing, understanding and interpreting it in accord with how we are capable of having an idea we wish to take to the market.

The boundary lies in giving exclusive consideration to our finance capacity, not wanting to share opportunities and risks with others.

8. People

These constitute the boundary. From the analysis of the previous boundaries in different organisations, we are able to conclude that in the end, behind all acts there lies a person. The person is who decides what to do with his/her knowledge, what to learn and what to unlearn. It is s/he who awards authority and s/he who takes it away, the one to share and keep, to create and destroy…

Confronting the organisation with its boundaries lets us find arguments for change. It makes us change the organisation itself, since it is a shared learning process, an expansive learning process. A process in which as people we can change our mental model and be aware that it is modified in each interaction with the environment.

9. Culture

Culture is the sum of the shared meanings of a group of people. Therefore, the creation of new bases to maintain hegemonic systems in which to establish social values depends on people and on the rhythm of change they are consciously prepared to support.

If we look back, we see that nothing is the same. However, being aware of this fact means living in the uncertainty of unbalance and we need handholds, barriers, boundaries that let us believe that nothing changes and afford us our sense of security.

10. Core competences

Understanding the key factors of our success and our failure, on which the critical aspects of our activities are based. In keeping with Leonard Barton (1995) and Prahalad and Hamel (1991), we can say that a core competence is something the organisation has acquired over time. It is something which represents a differentiating element regarding competitors and is therefore difficult to imitate. Furthermore, it is something the customer understands as providing him with value. Basically, these competences are held up by four pillars: the knowledge of the people in the organisation; the procedures; the physical systems; and the culture of the organisation.

The collective exercise of analysis of the Core competences makes us capable of analysing and understanding the key factors, which may be fundamental to supporting expanded learning and, consequently, the organisational change.

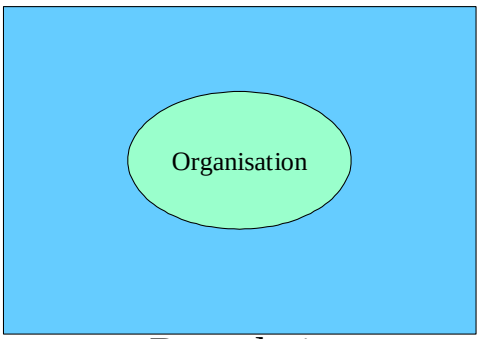
To identify the essential competences, it is necessary to set up a team dialogue enabling all the people in the organisation to share their mental models and find common spaces of trust, where they can understand and be understood and work towards a common objective. Some authors,. Such as Rafael Echeverría (1997) advocate the creation of a shared identity.

The essential competences of the organisation comprise this space of shared identity, as long as people are sincere and provide the debate with their way of seeing and interpreting reality.

IV. Conclusions: Creating a space for common understanding

The context in which the people in the organisation can understand each other and share a common purpose is based on the common elements of the mental models they are capable of sharing and adopting as their own.

Figura 3: Context of organisational identity



What is established is therefore a context of shared identity that becomes evident in interaction between people, in the act of sharing knowledge. We could define it as a network of relations.

A network of relations is never stable. It is a structure with an eminently dynamic development characterised by a continuous process of organisation. To use the continuous tense, it is always organising itself. Said change in relations is revolutionary and continuous. The unions, ties and boundaries that are established in all relations are always connected with others and are both sources and results of the change. Coleman (1988) states that the networks are wrapped in dense interactions and result in the development of behaviour norms that can create dependence.

At the individual level, the maintenance of the hegemony leads to manipulation and control strategies. The relations are established on the basis of the internal status in the organisation of each individual, the mental models of each person that forms a part of the organisation. The sub-culture in which s/he lives, the values, his/her personality and the ruling paradigm in the organisation mark the destiny and potential development of the organisation, giving importance to individual interests over group interests, and to group interests over global interests. The development of internal alliances, pressure groups (trade unions, departments, areas, etc.) mark the play and have a determining influence on the development of the organisation. The use of power and hegemony to achieve objectives marks the development of many organisations. The inertias and resistance to change are dominated by the fear of losing a certain position. The changes in the paradigm are determined by the change in the people who uphold the ruling paradigms and is usually the result of a crisis (Hamel, 1991).

In the scope of communication, as a basic act of interaction between people in the organisation, we must give fundamental importance to the principle of feedback. In other words, the information about what is happening nourishes the system and lets it adapt to new events. In this way, the traditional linear theory loses its importance from this moment on. (Norbert Wiener 1948)

Shortly afterwards, Claude Shannon published “The mathematical theory of communication”, which proffers a return to the linear model, ignoring feedback and giving key importance to information and transmission.

The later model by Roman Jakobson (1960), which remains in force today, is very similar to that of Shannon in that it does not overcome the linear model.

In the 1950s and returning to the very beginning, Gregory Bateson formulated a new theory of communication. This time, it was from an anthropological point of view, understanding that Jakobson's scheme was not designed for human sciences, which contains non-verbal and non-conscious phenomena. This author considers that the concept of communication includes all the processes through which people influence each other in a mutual way. One of the first axioms is that **communication cannot cease**.

They give more attention to the context than to the content and consider that the experimental method in which the variation of one element is correlative to another is inappropriate, since reality implies many more variations. It is not simple and linear, but rather complex and able to be contextualised. Based on the conception of communication as a cultural system in which the individual is inserted, they analyse how the system is ruled by circular, not linear, causality. In opposition to the linear model, everyone is a participant and no one is the source, cause or purpose of anyone (Winkin, 1984).

This reaffirms the analysis model proposed with regard to the base of the systems dynamics where organisational learning is established for development in an interpretative and simulative model in which it is not possible to consider all the context variables. However, it is as real as reality, since it always depends on the interpretation people give it.

Similarly, Maturana, Varela and Uribe, (1974) speak of autopoiesis, whereby living beings are living systems that produce each other indefinitely. Consequently, an autopoietic system is both producer and product. Living beings are the only self-producing machines and their product always consists of something that is different from themselves. As living beings need to obtain resources from the environment in which they live, they simultaneously constitute an autonomous and dependent system. As these authors state, living systems are structurally determined systems, whereby the structure of a given system is the way in which its components interconnect with each other without changes to their organisation. In accord with this structural determinism, what happens to us at any given time depends on our structure at that moment. In this way, the structure of a living system changes all the time. According to Maturana and Varela (1980), living systems and the environment change in a way that is congruent. Both the living system and the environment give each other constant stimuli and mutually influence each other. This compensatory behaviour has been called structural parity.

The world in which we live is the world we construct with our perceptions and it is our structure that makes us able to have said perceptions. In this way, our world is the world about which we possess knowledge. If the reality we perceive depends on our individual structure, there are as many realities as receivers, and therefore, objective knowledge is impossible: the observer is not alien to the phenomenon one observes (Maturana and Varela, 1980).

Consequently, organisational learning is determined by the interpretation of the context and this varies at each given moment in accord with our interactions with it. The process considered on the basis of the dialogue about boundaries, a dialogue that shares individual mental models and creates a common paradigm, seeks to make people aware of said co-evolution in an autonomous and dependent system and of the fact that everything changes even though we do not realise it.

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Intellectual Property Management: a TRIZ-based approach to manage innovation within SMEs

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Abstract: In this paper, we present a methodology and a working paradigm, based on TRIZ theory, specifically conceived for SMEs that are not able to face the problem of Intellectual Property Management (IPM) in an autonomous way. As a first step, we introduce the competences and possible company structure to manage and protect Intellectual Property by means of patents and trademarks; then we describe the methodologies and the tools, which can be used for IPM, such as those derived from TRIZ.

Keywords: TRIZ, Patents, Intellectual Property Management, SMEs

I. Introduction

The capability to manage Intellectual Property is becoming essential for SMEs that actively try to face competition of emerging countries and Far East (China, India, etc.). Nevertheless, some aspects are often neglected, such as the importance of patents, not only as a legal protection from unauthorised copying of inventions, but also as a tool for a systematic innovation of both product and process; in fact, patents can represent the starting point for systematic innovation. In this paper, we first introduce three possible organisation paradigms for SMEs that aim at managing internally Intellectual Property and at playing an active role. Then we present a methodology and its related tools, based on TRIZ theory, specifically conceived for those SMEs which are not able to face the problem of Intellectual Property in an autonomous way. The methodology, based on systematic innovation tools, regards the following key aspects: valorisation and formalisation of the company's technical knowledge, monitoring and acceleration of the innovation process, management and defence of the intellectual property by patents and trademarks and increase of SMEs autonomy in the management of the IP.

II. Organisational paradigms for IPM within SMEs

Traditionally, SMEs are reluctant to establish an internal department for Intellectual Property Management (IPM). However, creating a technical-legal Department is not so arduous as far as it concerns either operativity or investments in terms of infrastructures and human resources. In fact the synergies derived from such a department in the innovation area permit to create the conditions for self maintenance. To describe possible organisational paradigms we first introduce the concept of 'Standard Structure' for a SME. A Standard Structure is characterised by a R&D department and a Patent Attorneys whose role is to act as a legal representative for the company with regard to IP. Generally speaking, such a structure is not used to manage those IP issues related to the company's know-how and industrial secret, i.e., its technological wealth which is not protected by patents. The R&D department develops products mainly using information/data available from the other departments of the company (marketing, procurement, sales, etc.); while the Patent Attorney writes the new applications on the basis of information provided by the R&D department and follows the procedure for the grant of the patent. S/he is likely not aware of the company's know-how and industrial secret; therefore s/he cannot lead the company toward a consolidation of its IP. With reference to this standard configuration, we envisage three organisation structures characterised by different levels of IP-management, and precisely by: *active innovation management* (minimal solution), *internal management of IPR* (intermediate solution), and *advanced management of IPR* (optimal solution).

The first level implies that the R&D department plays a more active role: it manages the product development and performs the state of the art analysis using one or more patents search engine (e.g., Espacenet and Uspto) getting free from the traditional information channels internal to the company. The interaction with Patent Attorney becomes more active: patents analysis completes technical information necessary to write new applications; the R&D department gives an important effort to establish a communication channel between Patent Attorney and Examination Board.

The second solution envisages the establishment of an IP department that manages and transfers the company knowledge, creating communication channels between the R&D department and Patent Attorney. At this level, the IP management mainly consists in analysing and monitoring the state of the art. The patent Attorney remains and the IP department in case of technical analysis and patent litigations technically supports him/her.

This last structure implies an IPR department working in coordination with the R&D department, the Patent Attorney is not needed anymore because his/her role and technical-legal tasks are completely assumed by the IP department (see figure 1). The IP department directly manages the legal aspects of Patent, included grant procedures, hearings and litigations according to national and/or international Patent Conventions. The IP rights management mainly concerns: monitoring of the state of the art; promoting of studies and consultancy services in the field of IP; evaluation of patent portfolio in relation to the company's know-how and industrial secret. The use of specific methodologies (e.g. TRIZ and GTI) and tools for systematic innovation (e.g., CAI tools) and semantic-based search tools allows the synergy between the IP management the R&D department, both involved in product innovation processes. These last ones permit to consolidate and enhance product innovation processes and to stress the developments of new inventions with respect to the state of the art. Thus, the IP department acquires an added value/benefit not available within the other company department.

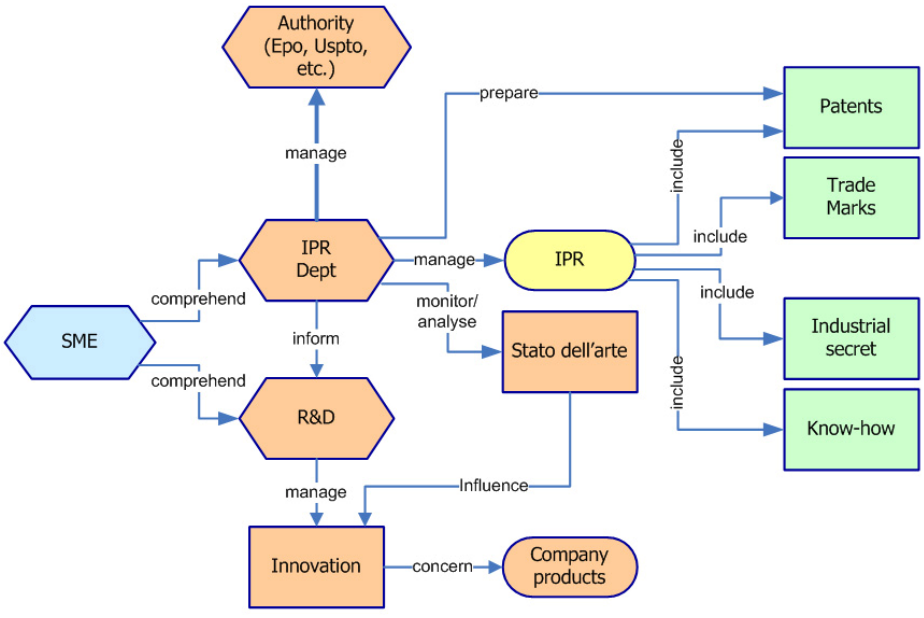

Figure 1. Structure with advanced management of IPR.

III. TRIZ methodology and Patents Management

In the following, we will introduce some tools that can be adopted both by IP and R&D departments to enhance IPM and innovation. As previously mentioned, the suggested methodology bases on tools, which are an integrating part of the TRIZ theory (Altshuller, 1984) (Ikovenko, 2000) (The TRIZ Journal, www.trizjournal.com). TRIZ was developed by Genrich Altshuller (1926-1998) and his research staff since 1946. Their goal was to capture the creative process in scientific and technological area, codify it and make it repeatable and applicable (Savransky, 2000). Altshuller started his work screening patents (over 1,500,000 patents have

now been analysed), looking for inventive problems and how they were solved. Functional analysis, Technical contradictions and Inventive Principles can be used, among the several TRIZ tools, in order to manage technical knowledge and patents.

1. Functional analysis and knowledge valorisation

The Functional Analysis provided by TRIZ, combines the subject-action-object (SAO) logics with the value engineering thinking (Miles, 1972). It formalises the technical knowledge through two types of models based on functional decomposition of a system: the Function- Tree- Diagram and the Functional Model (FM). In particular, FM takes advantage of a simple graphic language, which permits to identify every component of a system/product, its role and functions (both useful and harmful). In the field of patents management, functional modelling is particularly useful. First, it allows to schematize a technical system in a synthetic and objective way, whether one has to describe a new invention in a patent (figure 2a) or has to analyze a patent to understand how the invention works (figure 2b).

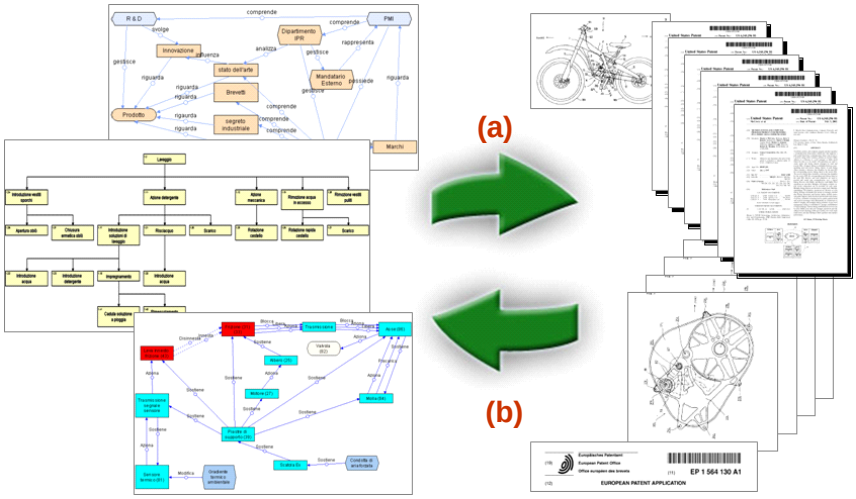

Figure 2. Functional analysis and Patents

For both flows, functional models represent, in different contexts, an impartial coding of the knowledge. Said coding is usable for the analysis of patents extensions, patent-breakings and representations of technical knowledge. The functional description of a technological apparatus or of a company department permits to construct a balanced linguistic structure, leaving untouched the action-reaction-principle between subject and object (SAO) but eliminating descriptive redundancies. If a patent is being analysed and modelled, a good work highlight strengths and weakness of the device described, creating a robust base for eventual patent breaking or circumvention. Bad models may bring to wrong evaluations of what is claimed in the patent, with potential severe and expensive legal consequences. The everyday language decades replaced by the representation of the direct interaction between subject and object. Therefore, functional analysis constitutes a valid tool to share and spread out a technical knowledge inside (and outside) the company. The description of a user handbook, or of a patent, written according to the functional analysis has proved to allow a univocal translation into different languages. This can be of a particular importance in litigations as misunderstandings or wrong translations could be avoided.

2. Contradictions-Inventive Principles and Innovation Monitoring

Contradictions are one of the TRIZ basic concepts. A contradiction occurs when improving one parameter or one feature of a technical system, the same or another feature or parameters are negatively affected. TRIZ states that when a solution overcomes contradictions this is likely to be the most effective inventive solution. Altshuller extrapolated from the worldwide patent databases 40 inventive strategies (named Inventive Principles) to help an engineer to find highly inventives (and patentable) solution to a problem. From this basis, he developed a matrix (named Contradiction matrix or Altshuller matrix) whose cells contain the principles, which should be considered for any kind of specific situation.

In IP management, Contradictions can be used to monitor innovation by classifying patents on the basis of contradictions type and associated solutions thus concentrating the inventive efforts on specific objectives. On the other hand, identifying the technical contradictions present in existing products, either proprietary or owned by competitors, should help in understanding where and how to improve the products and speed up innovation. Functional analysis provides a valid support for this activity, i.e., contradictions identification.

Traditionally, Inventive Principles are used as a tool for problem solving; however, analysing patents one can trace the inventive principles used and, outline a trend-evolution of the new idea. Similarly to contradictions, Inventive Principles can be used for different purposes: to classify patents by the most relevant inventive principles instead of classifying them by branch, such as automotive, electronics, aeronautics, etc., or to monitor the innovative process inside a company or of a specific industrial sector by recognizing/identifying the most used principles (Nani 2005, Nani 2006) (see figure 3).

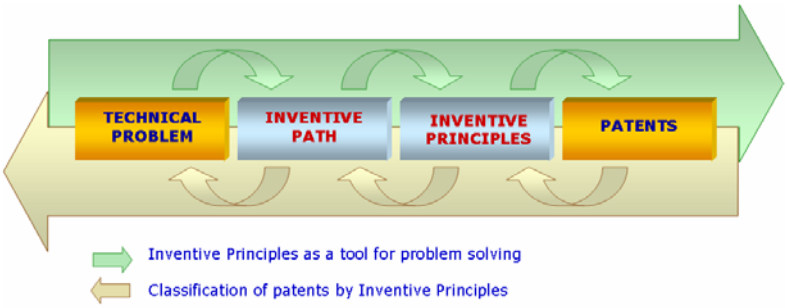

Figure 3. Inventive Principles and Patents

Thus, classifying patents by contradictions and/or inventive principles should allow a company to define its Intellectual property strategy, which will consider patent analysis and patent breaking whether favourable or unfavourable to the company.

IV. Conclusions

In this paper we have introduced possible organisation structures for SMEs that intend to face the problem of Intellectual Properties in an autonomous way. To this end, we present some tools typical of TRIZ methodology that can help to deal with some specific issues of IPM. We have mainly stressed the opportunity they offer to upgrade the quality of IPM by means of innovative methods and qualified personnel with scientific-technical background. Both patents monitoring and functional analysis permit to build up a precious synergy and to accelerate product innovation inside the company. Thus, TRIZ methodology can represent a valid tool to interlace IPM and new product demand with a systematic and rational approach.

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A practical framework to apply innovation concepts in the exploitation phase of collaborative R&D projects

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Abstract: The makers of this paper work in the Strategical Innovation department of Ikerlan and have wide experience on applied research on collaborative innovation in industrial groups of the Basque Country.

Practical application researches use the reference model defined in the BE3P research project, a specific collaboration experience in the field of innovation management between the university (Mondragon Unibertsitatea), the technology centre (Ikerlan) and five industrial companies (Ulma Packaging, Orkli, Geyser Gastech, Fagor Ederlan, MCC Componentes).

This paper shows a framework that, using BE3P reference model, applies key innovation concepts to the exploitation phase of collaboration projects (ex: European projects), as it is well known that they are usually an optimistic collection of spreadsheets that lack of reflection to evaluate real market opportunities. So, the main objective of this framework is to facilitate the related reflection to define spaces of market opportunities, business models, selected strategic business plans and New Projects Development Plan.

This framework is being used especially when technology and research results have to be exploited on emerging or instable markets (examples in telemedicine and welfare) and facilitates tools and results to build a bridge between R&D collaboration projects and entrepreneurs.

Keywords: "collaborative projects"; "innovation frameworks"; "R&D exploitation"; "emerging markets"; "entrepreneurship".

I. Introduction

When existing literature debates about innovation understands this concept in different manners and deploys different methodological approaches for this up-to-dated paradigm that improves competitiveness responding the market with new products (or services).

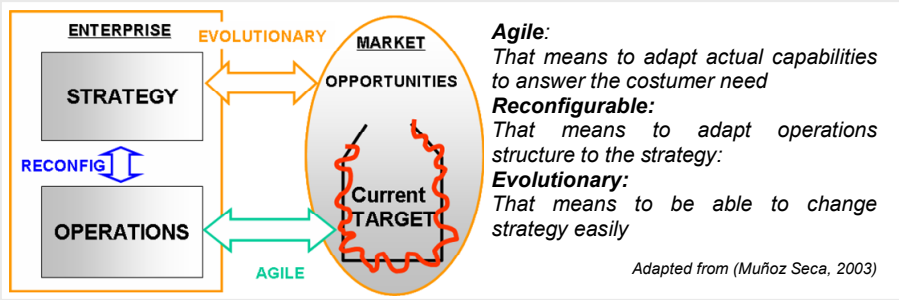

Figure 1 – Different types of innovation capabilities to respond the market needs

But as it is shown in the figure 1 (Berasategi at Al. 2005) improvements can affect in different manner to the relationships between Enterprise and Market. The framework developed that is exposed in this paper relates with the so called disruptive technologies (Bower & Christensen 1995) that have the potential to scratch out actual market boundaries and build new ones based on new opportunities. It is widely noticed that to be a champion in innovation on disruptive technologies the enterprise organization must have a high level of evolutionary capabilities.

II. Conceptual background

The concept of innovation defined long time ago as "creative destruction" by Schumpeter (Schumpeter, J, 1934) has become something of a buzzword in the recent literature on technological change. The "Winds of Creative Destruction" have traditionally moved slowly but have redefined the way industries conduct business. Schumpeter describes capitalism as an economy system that finds its competitive strength in innovation. His "Innovative Activity" (creative destruction) is clearly driven by what today we call disruptive technologies. Abernathy and Utterback (Abernathy at Al, 1978) emphasize this in describing ***disruptive technologies*** as those that generate entirely new ***technology-product-market paradigms*** that in turn create new market that initially may be opaque to customers. Opaqueness, they note, constraints customer enthusiasm for varying established behavioural habits.

As we illustrate afterwards, searching potential technology-product-market paradigms and clarifying new opportunities to potential customers are the main challenges of any action in innovation and is the key concept, usually lacking in R&D collaborative projects, that is performed in the practical framework defined later on.

As regards the ***method to commercialize disruptive technologies*** there is an important contradiction that has to be considered: we can focus on the ***technology-product*** or on the ***product-market*** interface. Researchers experienced on disruptive technologies decide to emphasize on technology-product area, as we can read in MANCEF (2004). The disruptive technology based products, as Microsystems and Nanotechnologies, can go to compete in numerous market and industrial spaces. The efficiencies and performances generated at the technology-product interface define the competitive winners at the product-market interface. This causes problems for business professionals, who have been taught to be market-focused (condition known as marketing myopia). Consequently, ***technology pushes*** versus ***market pulled*** approach is one of the characteristics of technology applications in the "era of ferment".

Finally, to characterize the ***different type of research actions on innovation*** we refer to the Oslo Manual 3rd Edition (Oslo Manual 2005) that gives two clear references to measure and classify innovation. It establishes a difference between innovation capabilities and innovation actions. It defines two ways to improve those capabilities: by action learning from innovation projects, or by management changes. It also distinguishes innovation actions in product, process, marketing and organization. As a summary we interpret that, in this conceptual framework, to innovate means to implant a radically improved new product (service), or process or a new market paradigm or important changes in organization and management culture.

III. Background of research actions fostering innovation

The infrastructure framework has been developed as a result of a bunch of different projects that spread the knowledge experienced in the BE3P project in practices. As it is more detailed in Goenaga at Al (2004) this project has been experimented with several industries and it aims to guide an enterprise in their path to become an innovative company.

The present research experiences, related with actual demand of industries, can be categorized in three groups: Systematic Innovation, Watching Opportunities and Value Road-Mapping.

- Systematic Innovation projects have a global approach and two different views. Some projects are leaded by organizations very close to the government staff and concern with territorial objectives to improve the quality of the management techniques of innovation and its innovation support net in one specific region. Other projects have been developed to implement systematic innovation in enterprise corporations concerned with the risk of disruptive technologies acting Down-Top (Christensen 1997).
- Watching Opportunities projects build technology watch infrastructure that support collaboration networks and maintenance of dynamic pool of ideas. These projects are usually embedded in the strategic processes of industrial members (Zugasti et Al 2006).

- Value Road Mapping (VRM) projects. In these projects the method used is oriented to emergent technologies and in cases having different options to compete and several possible exploitation plans. Usually there is not financial consistent data and uncertainty is very high. VRM is strongly recommended to support the identification and exploitation of technologies in a very early phase or to explore potential markets of some specific technologies (technology push approach). Figure 2 shows a practical case of Value Roadmap on energy technologies made for Ikerlan in collaboration with CTM[1]

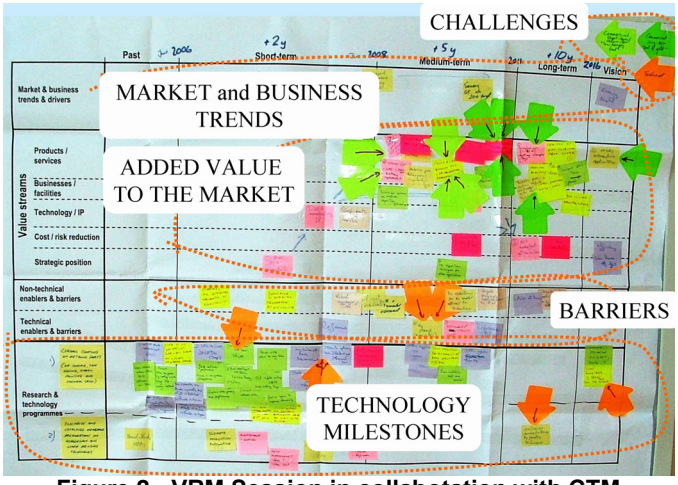

Figure 2 - VRM Session in collabotation with CTM
CTM, Centre for Technology Managemet
University of Camdridge

IV. Building the framework to generate realistic opportunities from disruptive technology based project.

As we said before, there are several types of innovation projects that help in the path towards an innovative company. Here we will describe the main steps and tools of a framework to insert innovation into R&D collaborative projects by defining and launching exploitation plans based on a process of reflection to evaluate real technology, product and market opportunities.

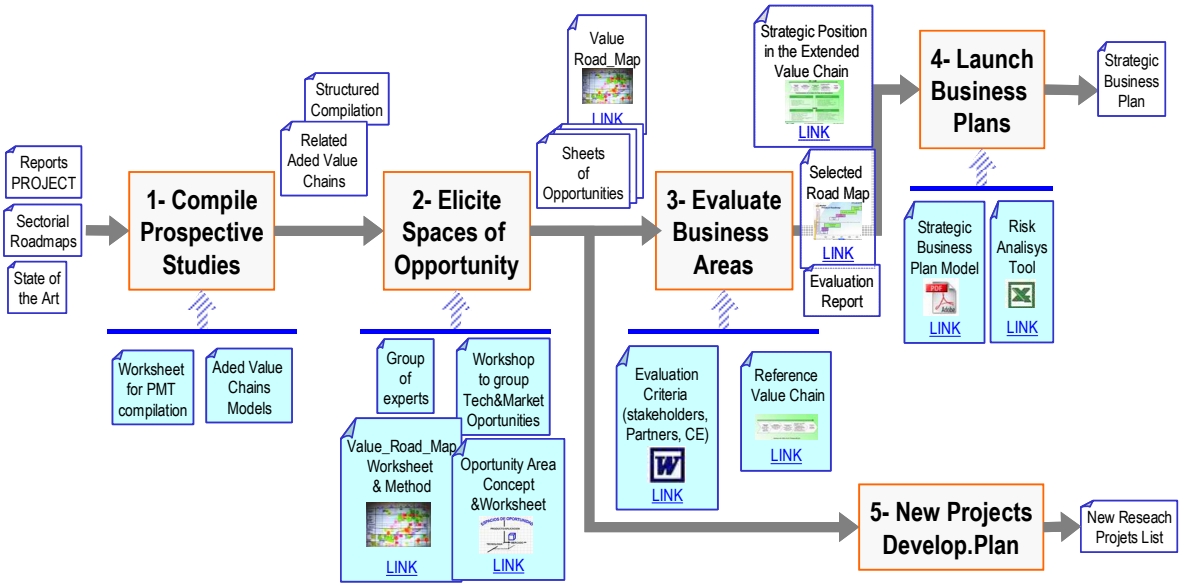

Figure 3 – Steps and tools defined to foster innovation on R&D Collaborative Projects
inputs, outputs and activities are in blank– supports are coloured)

The proposed method to develop the exploitation plan in such a R&D collaboration project takes into account all aspects drafted in the project proposal, and plans a detailed step-by-step outlet to launch to the market the opportunities of the project. The objectives reached are:

- To identify business opportunities in the field of technological developments of the project.
- To set down the business models associated with the former identified opportunities.
- To evaluate and select business opportunities and models.

[1] CTM, Centre for Technology Management. IfM, Institute for Management. Univ. of Cambridge

- To launch the Strategic Business Plan of the product and services selected.
- To define New Projects Development Plan to reinforce challenges spotted in the Value Road Map carried out in relation with the project.

V. Main conclusions

As a result of research experiences up to now these are the highlighted conclusions:

- Searching potential technology-product-market paradigms and clarifying new opportunities to potential customers are the main challenges of any action in innovation. It is the key concept, usually lacking in R&D collaborative projects, that is performed in this framework.
- From the research experience, it is noticed that the use of VRM method gives the opportunity to match technology-product and product-market interfaces.
- It is necessary to remind that although excellence in management is important, value has to be materialized in the market. There is not enough investment in "strategic clarity" to know what to do with technological achievements in R&D Innovative projects. Potential innovation is not efficiently exploited.
- It is very recommended that entrepreneurs may joint very early the project team: in the step 2 creating the Value Roadmap and, of course, in step 3 defining the strategic position in the "Extended Value Chain" targeted. Having entrepreneurs so early opens minds and permits to overcome the "marketing myopia".
- We recommend collaboration in R&D Innovative projects with educational centres on entrepreneurship techniques. You can see this idea exposed in Solé 2006.
- It is widely noticed that to be a champion in innovation on disruptive technologies the enterprise organization must have a high level of evolutionary capabilities, which lack on corporations with a traditional management paradigm.

We finish saying that disruptive technologies (as Microsystems, Nanotechnologies or Energy) need technology push, but also a market pull because this technologies create emergent markets (as in medicine, telemedicine, food and wealth) were opportunities are opaque not only for technologist or entrepreneurs but even for customers.

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About the transferability of behavioural skills

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Abstract: The strong instability of the economic, social and political environments requires reconsidering the organization of work. Employees are supposed to be able to move in between several companies and functions, in brief to develop their own adaptability and flexibility. This phenomenon concerns the main socio-professional groups such as young people, seniors, low qualified people and executives. All of them have to wonder about their future in agreement with companies, trade-unions...

In our research-study, we will focus on people with "low levels of qualifications".

In organizations, the "model of competence" allows to understand a member of the organization not only through his working station but also according to his own skills. We will consider the competence as it is generally defined in the literature of management that is to say in accordance with three components: knowledge, know-how, knowing how to be (also called interpersonal skills, relational skills; social skills and so on). In our article, we will call these skills behavioural skills.

Within the framework of this article, we would like to study the transferability of knowledge focussing on the transferability of behavioural skills.

Keywords: behavioural skills, methods of learning, transfer of knowledge

I. Introduction

Other the last few years, French labour market has gone through paradoxical evolutions. On the one hand, a lack of work force is noted in many branches of industry (craft industry, public buildings, hotel business, for example). On the other hand, some other branches are affected by the effects of internationalisation, carrying on with delocalization and thousands of redundancies. For these people, who often knew just one employment in these factories, who were not very mobile because of their family circumstances and who where usually little qualified, it becomes difficult to find an employment in a new context.

At the same time, companies specialized in temporary job require people of low and average qualification in large numbers, who are able to adapt quickly to multiple work situations.

How can we imagine that there is not convergence between resources and needs? How can we explain that companies specialized in temporary job cannot satisfy the offers they have whereas more and more people are without job in the labour market?

Some brief replies to this paradoxical phenomenon can probably be found in the concept of employability.

II. Link between employability and transmission of skills?

Employability (Le Grand Robert) is the "capacity to acquire and maintain necessary skills to find and preserve a job". This definition seems interesting as it indicates the individual capacity to be maintained in a position and to find another job. Each person acts for his own employability. However, employability is widened to an organisational dimension (Finot, 2000). So,

employability is considered as the necessary skills and the necessary human resources management to allow the employee to find a new job at any time. As Le Boterf stresses it, employees have to insure their job and to adapt themselves to the evolution of their own job. (2005).

This underscores the necessary involvement of the company while introducing the concept of competence.

So, developing employability among employees amounts to setting up an adequate management of skills in a company. It would make possible to integrate the various components of the competence including technical know-how, behaviours, attitudes and knowing to be[1] (also called interpersonal skills, relational skills; social skills …) (Bellier, 1999).

Competence is the result of three components: knowledge (head), know-how (hardware) and knowing how to be (heart) of the person (quoted by Durand, Pestalozzi, 1797). However, the reference research works in the field focus on management, on the transfer and the capitalization of knowledge and know-how. On the other hand, few works have approached the issues of management, transfer and capitalization of Knowing How to be, also called behavioural skills. Therefore, the question of the identification and the acquisition of the behavioural skills arises.

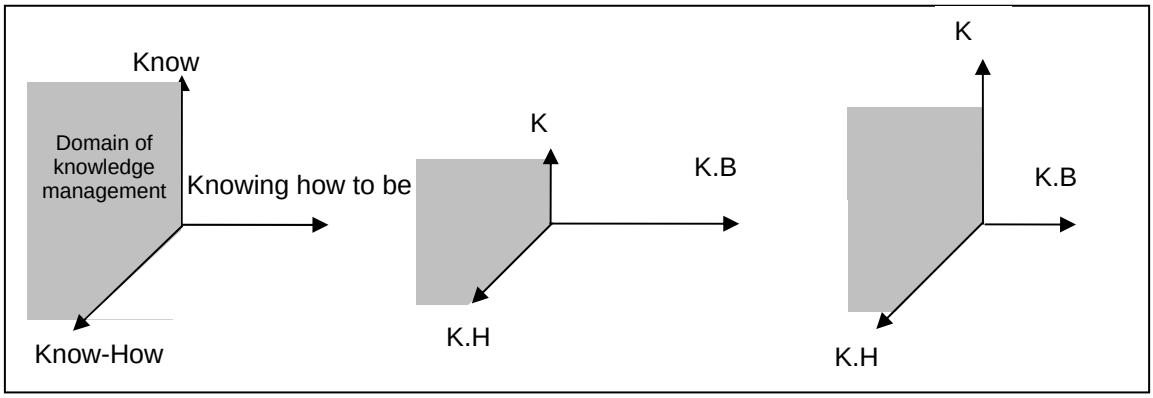

Diagram 1: Knowledge management zones of polarization according to skills of each person

III. About behavioural skills acquisition

Behavioural skills acquisition refers automatically to the concept of “learning”.

To enhance the learning of behavioural skills implies to identify the components of behavioural skills and learning situations. These two stages help understand the modalities of skills transferring.

A research realized in partnership with a European group of temporary jobs enables to give a 27 behavioural skills’ cartography. In the next diagram, Skills structured in eight groups are presented:

[1] Savoir-être in French

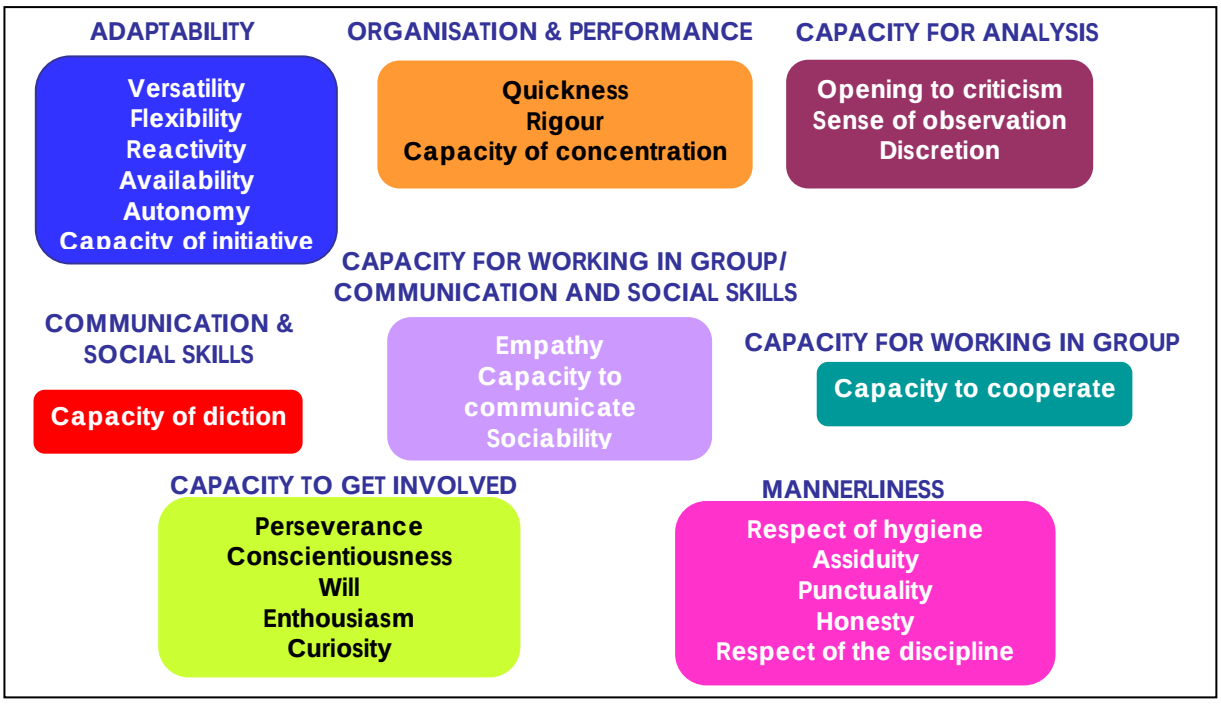

Diagram 2 : Cartography of behavioural skills

From now on, possibilities of acquisition of behavioural skills through relevant situations of training must be considered. Thus, individual learning can be defined as the process by which a person acquires new skills. Experience, training, or information are at the core of learning. . But, as Fillol remarks, it is also necessary to underline the outcome of the training (What do we learn?)

According to Grundstein and Rosenthal Sabroux, (Grundstein and Rosenthal Sabroux, 2001), skills are a mixture of knowledge, capacities to act and goal oriented behaviours in any given situation. Therefore, the definition comprehends the capacity to gather knowledge and to put them in action in a context. Similarly, during the research with the European group of temporary job, we noted that the behavioural skills and the situations of work are closely intertwined. Indeed, some skills will be particularly essential in certain situations of work (for example empathy skills will be more essential in situation of work in relation to the customer).

In a learning situation, the three skills of knowledge, know-how and knowing to be cannot be completely dissociated. They are in permanent interaction and cannot exist independently. Indeed, skills of knowing-to be are useless if they are not mobilized within a background where knowledge permits the comprehension of the stakes, the strategies and authorizes a process of actions (know-how). Reciprocally, knowledge remains useless if it is not associated to know-how and to knowing how to be.

To support the acquisition of behavioural skills, people should become aware of their importance. In the same way, each individual should be able to detect this importance, and, finally, to establish links, to build connections between two situations.

A new field of research opens: the process of learning of behavioural skills is still little studied. Behavioural skills are the result of training, of professional and personal experiments, of each individual's personality and of the strong interdependence existing between these elements. As Nonaka and Takeuchi worked in the identification of the knowledge movement specifying the cycle of knowledge conversion (tacit-explicit), according to this model, we wish to go deeper into the detection of situations and of elements supporting the acquisition of behavioural skills.

IV. Conclusion

Argyris and Schon underline that « individual learning builds up the learning of organisational skills, which in turn improve individual learning". So, the person is at the core of the organizational learning. The knowledge of members of the organisations modifies and makes richer the learning of the organisation. Comprehension of learning of behavioural skills opens prospects in terms of knowledge creation and in conclusion in terms of innovation.

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Staffing by Explicit References

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Abstract: To use explicit references in planning and assessment has specific advantages. It is a way of controlling the entirety of overviews and it helps co-operation and participation in complex bureaucracies. It is a way of organizing setting priorities so that the alternatives eliminated become visible.

In a recent study for the Swedish defence a series of references were applied for the composition of different competences in urgent staffing missions: James Miller (1978), de Raadt (2000), Elliot Jacques (1996), Eric Albert (2005), Marion Saumonneau (2006) and of course the HR-XML. We made taxonomy for the competences required but we also found that an iterative procedure with more than one taxonomy would be a preferable method.

Keywords: Competence, staffing, templates, systems science

1. Innovative Management Practice

I perceive innovative management practice as a kind of procedure where thinking is joined with action and communication. Most innovation comes from thinking but not all. You discover when you do. You have good and bad surprises. You have the devil in the details someone said. I had my latest surprise when I used James Miller's input-output model to classify competences. The model did not work as it had done many times before and as the client had expected. We should not have been surprised though. Philosophers like Bordieu (1992) and Luhman (2003)are clear enough about the limitations of simple branching taxonomies. Anyhow after a brute effort trying to specify in James Millers framework we tried a multi perspective methodology.

But was this *innovative practice*? Surely it was not the kind of brilliant solution or combination that is the mirage of Edward de Bono (1973), of Martin Gardner (1970) or of the charming French Eureka (1979). In my project it was rather a *take care of* ex post and it came by work, not by brilliant thinking. But there was innovation also. It came from Brussels and it was founded on a new vision of the world. Defence and diplomacy had to be integrated for new security policies. Europe integrates. Sweden no longer has got any problematic borders. Precaution became pro-action and the latter consists in launching troop when Brussels calls. Moreover we do not know many weeks in advance which troops are to be sent. Sweden does not send trained battalions. It sends trained people who are to be selected and put together according to specific needs expressed each time by the European Commission and the Swedish Government

There is innovation on two levels: in the general world-view and in each call from Brussels. And each time it is urgent. So structures and routines for the nation who responds must be prepared. Participating countries are not given many weeks for recruitment and training. Here, if ever, we see that innovation is not just the idea. My project had a very small role in making Brussels innovations real but I felt that we were doing innovative management *practice*.

2. The mission and its context

My project, as many others, started with a precise question: "Make us a taxonomy for competences!" Thinking about Jean Louis le Moigne's projectivity concept (1995) I asked about uses and contexts for this taxonomy: It should be there for a sequence of functions:

Recruitment, formation, staffing, reorganization, action, follow-up.

These functions in their turn are composed of the following activities:

Requirements specifications, their translation into formal criteria, shaping and update of databases, matching persons with jobs, negotiations and employment decisions.

Our linguistic taxonomic efforts had a major focus of translating Brussel requirements into troop requirements. The subsequent matching of individual requirements into database and search engine language was another issue with some commitments already done. A soft-ware, Match-IT, could search in many ways including by free text.

3. The project

The client's earlier established requirements specification for competences, including a use of the well established HR-XML structure, survived a matching with the systems model of James Miller. That model then became a framework for a taxonomy of all the competences needed. However, further testing of our a priori requirements with other models showed that lots of psychological qualities were missing. This subsequent testing led to substantial amendments of the Military HQ's language for personnel specifications. More general human qualities were added in a vein of Peter Senge, Eric Albert and Marion Saumonneau.

The subsequent matchings also led us to a revised methodology. We came to question the idea of one single taxonomy as a language for competencies. We started instead the design of a multi perspective procedure. It could start with any kind of a pragmatic or theoretical setting, but it must continue and be modified by theories from systems science and from the human sciences. It is likely that we will end up with a very flexible methodology neither stating a fixed taxonomy nor a fixed sequence of perspectives. The latter could be chosen according to the intentions of the troop to be designed. If a troop is to have qualified coordinating roles for example, the taxonomy of Elliot Jacques would be useful. For many military missions it might be enough to run two perspectives, a professional/technical one and another more psychological one.

The amendments of the old menue of competencies came as no surprise to my client, but he was pleased to have explicit suggestions of perspectives and of a method. Those will be brought forward to a handbook for staffing in international missions. In this way our project conforms to the general HQ rule that flexibility shall be designed by *Network Centric Enabeling Services*.

As a menu of guiding perspectives we first suggested James Miller and Stafford Beer (1974) who design coherent structures of connected flows and transformations. John P van Gigch (2003) also offered this kind of organic coherence, but in a metaphysic world view. He sees and draws the process of building knowledge.

The organic flow models guarantee a certain completition in the overview, but the level of abstraction is not really convenient for our staffing work. Something generic, more scholarly and more generic is needed as a complement. So, Albert, Jacques and Saumonneau were tested. Other authorities were discussed but not explicitly used. You may find this discussion in the complete consultancy report (in Swedish) by the web link www.agrell.info. However, most of all the non-organic models offer a pragmatic rather than a systemic overview, which is less easy to pin-point and explain to partners and stakeholders in the personnel management process.

So what is new enough for a scientific audience in this paper?

- We have a Cartesian (1637) explicitation of a competence management process.
- We have gathered a set of relevant systems structures for competence descriptions in personnel management.
- We have made an experiment in using systems structures to test and supplement an older view on competences. This experiment initiated amendments. The experiment is then suggested as an archetype for a regular procedure mixing intuition and patterns. This procedure is a specification of the principle of multiple perspectives, which too often is expressed only as a pious wish.
- We see that you discover by known patterns, not only by experience, intuition and pragmatics,
- We offer a philosophy about using patterns for discovery, co-operation and democracy.

4. A client's reaction

There was complete agreement about a need to improve the existing conceptual framework for personnel requirements specifications. We also had a common hesitation over whether the need for multiple perspectives could be reduced to just one or two taxonomies.

My immediate client was pleased to apply systems thinking both as patterns and as something to relate to in different ways. This general enthusiasm spread over into recommendations for the military academy's attention to modelling and systems science.

Another interesting reaction was the willingness to discuss different taxonomies. Abstractions of that kind are not always so popular in spite of all management science recommendations to bring problems to generic levels. It remains to be seen however how willing the real hands on personnel managers are to discuss their basic assumptions in this way. The latter will also have the question about how to handle the necessary multiple perspectives: in one, two or more iterations. The goal is to agree, write and teach a handbook of personnel management.

How to learn, develop and teach abilities of crisis management will be developed in other projects in collaboration with civilian authorities and research establishments. The projects multi-perspective view on competence will be used in those. My client is pleased that the project is presented at the ESTIA and he encourages me to listen carefully to critics and comments.

5. A discussion

Jean-Michel Larrasquet (2007) writes about *prison langagière* and *illusion ontologique* quoting Michel Foucault. These expressions describe accurately the state of affairs before our project started and they also say that care must be taken not to go into another linguistic prison by producing a ukase and by having it transmitted through the military hierarchy. So three things may seem impossible: to keep an obsolete view of competence, to impose a conceptual framework on the real personnel managers and to discuss abstractions such as world views beyond their feelings of relevance. The abstract dialogues are not so easy in real management though authorities like Checkland (1985) and Larrasquet (and myself) plead for it. The imposition by the hierarchy is not as easy as it used to be, not even in a military organization. However, an agreed need for computer support in the new situation of world security and preparedness for rapid reaction may still make a conceptual change possible.

My client was a group of planners from the central headquarters. They were not the ones to really do the staffing job in the future and we had surprising difficulties to capture the latter into our project. One of my major tasks, I found, was to persuade my client that those have to be involved even before any conceptual taxonomy or main line of staffing method could be settled. This does not mean that we should strive for a pure consensus procedure and product. That would have been to return to an earlier state already falsified and rejected. Our systems and science results really had to be transmitted into practice – to conform to Brussel's new urgencies and to assure a modern competence profile including human qualities for our troops. We must launch a new conceptual worldview of competences and we must be prepared to modify by dialogue. We must also discuss the concrete method of introducing new relevant perspectives into the language of requirements specification.

What I am less willing to question is the need for explicit transparent structures both for the views on the concept of competence and for the steps in the personnel employment procedure. I see the following reasons:

- To have an overview of a kind that can be defended and explained to others,
- To be able to approach an exhaustive completeness by the use of a series of explainable patterns,
- To enable better presentations to partners and politicians
- To open up to criticism and further developments by transparency and traceability,
- To help setting priorities and to enable the demonstration of both accepted and discarded options,
- To reduce lobbyism and local logics to defendable roles,

- To make consensus procedures honest with responsible world views and defendable foci,
- To make defendable links in a chain of requirements specifications containing both human and computerized nodes,
- To make comparisons fair,
- To capture the relevant competences,

So far this is for staffing procedures, but I have also earlier experience with this kind of explicitation. It works sometimes and sometimes not. From a method's development point of view I think it is important now to describe situations to see how they differ and to see their specific methodological requirements.

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Symatop – a web based platform giving a flexible and innovating tool for decision making and for human and process development.

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Abstract: This paper aims to present a web based tool that is developed to face complexity of human behaviour in situations of changes, recruitments and market developments…"Dominant Factors Analysis®" (DFA) is an exercise of simulation of attitudes in order to understand professional behaviour and to be able to act on company strategies, values and politics. DFA has as target to simulate clients, partners, employees and/or candidates preferences in order to understand and anticipate deviances in a strategy or in professional behaviour.

Keywords: Flexibility, creativity, innovation, usefulness

I. Introduction

"In a few hundred years, when the history of our time is written from a long-term perspective, it is likely that the most important event those historians will see is not technology, not internet, not e-commerce. It is an unprecedented change in the human condition. For the first time ,they will have to manage themselves. And society is totally unprepared for it." [1]

In today's world of knowledge, the purpose of the tool presented in this paper is to bring light of the behavioral aspect of a person or a group by focusing on the persons or the group motivators in order to accompany people and companies in the challenge "to manage themselves".

The methods used for this tool is based on a long tradition of research within behavioral and neural science mixed with the latest web techniques.

II. Who is Symatop?

Symatop is a French company integrated in the AILE incubator, French Minister of research, in May 2005 (www.aile.fr/france/sciences-sociales-216.htm).

The company was founded in Limoges in the centre of France, in July 2005 by Maggie Rousselle, Marc-Antoine de Sèze, Yves de Tonquedec, Serge Rébeillard and Cécile Kreweras (both inventors of this methodology), Lionel Fleury and Thierry Charbonneau.

III. What does Symatop do?

Symatop has developed a multilanguage Web based platform that is dedicated to accelerate the decision making process. It is managerial tool that focuses on the evolution of people and processes. This tool is developed to face complexity of human behaviour in situations of changes, recruitment and market developments…

The DFA is an exercise of simulation of attitudes in order to understand professional behaviour and to be able to act on company strategies, values and politics.

If we try to give a definition, we might say:

DFA is a tool that enables in-depth diagnosis and evaluation of the preferences, choices and opinions of a group of people who are concerned with a problem common to the group.

The tool gives total freedom to user to use it according to the specific needs. Examples of areas of usage are:

- Recruitment/Personal development plans/Integration processes/Detecting potential/Coaching, individual or group…
- Team building /Team Binding
- Identifying company values/Identifying gaps in strategy/Market analyses/Customer satisfaction...

[1] Peter Drucker

The fundamentals of the tool come from the Kernel® that was elaborated about 20 years ago. The Kernel is based on the work done the last 50 years by Scientists acting in behavioral and neural science[2]. The effects of interactions between the three brains *(cortex, limbic and reptilian)* have been elucidated. The DFA is based on those woks and draws from them numerous consequences.
Symatop disposes of the rights for the Kernel[3] in Europe and North America and has developed a Web platform in order to be able to use the tools per distance. Symatop uses this tool in order to innovate from a solid mathematical base.
New concepts are created depending on the needs, values and strategies of the clients and integrated in the Kernel concept.
Certified Consultants, Coaches and Companies use and adapt the tool according to their clients. The creativity of this tool makes it unique on the market.
Symatop works with a number of universities around the world in order to spread out some new aspects and utilization of the tool, based on semantic and mathematical approaches, not yet completly worked out.
Paris Dauphine, laboratory LAMSADE www.lamsade.dauphine.fr ,Laboratory 3IL www.3il.fr , University of Limoges and University of Colombia.

IV. How does the "Dominant Factors Analysis®" work?

The DFA is based on 30-60 cards with adapted phrases (statements). The phrases can be based on company strategy *(Ex. : In order to become the largest company in our sector we need to invest in direct marketing)* or professional behaviour *(Check information by going back to its source whenever possible)*. These cards will then be placed by the indicators on a chart of 100 positions.

The indicators can be adapted according to the needs. Below are some examples:

I consider it very important	It is important	It is less important	It is optional
It gives me energy to do this	It takes some energy to do this	It takes quite a lot of energy to do this	It takes very much energy to do this
This is very urgent	It is urgent	It can wait	It doesn't have to be done

Figure 1. Some examples of indicators

The exercise is made in four steps:

1. A general, spontaneous, selection into the four main preferences.
2. A regrouped selection within each preference into 5 new selections. Here the purpose is to search for professional experiences, mind images.
3. A last selection is a fine tuning within the 20 potential groups the final priority in order to create a total prioritisation.
4. A choice of action points among the phrases. This last points puts the person in action and a choices are made that later on will be part of the personal action plan.

Now each card is selected in a hierarchy and this prioritisation gives an unique overview of selection of preferences of each person.
The answers will be processed in a statistical and mathematical program.
Then the Kernel results are presented by four main areas:

1. Hemispheric dominance – Right and Left brain
2. Universes – Sensitivity and Intelligible
3. Territories – Vision (synthesis, openness, change), Affect (sensitivity, openness to others, group), Raison (analyse, objectivity, evaluation) Control (achievement, reliability, conformity)
4. Main types – conception, proactivity, mastering of the environment, management of emotions.

[2] Roger SPERRY, Paul MACLEAN, Robert ORNSTEIN, Henry MINTZBERG, Ned HERRMAN, Henri LABORIT, Antonio DAMASIO, Lucien ISRAEL, etc.
[3] **"Kernel®" , " DFA"** have been created and developed by Serge Rébeillard and Cécile Kreweras, associates in Symatop.

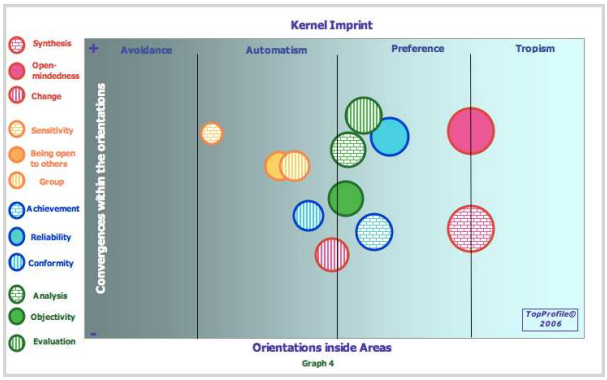

Figure 2. The Territories and main types give a unique picture of the professional behaviour of the individual

The results are given through a personal coaching and a document of 30 pages with personal action points. The feedback can be given by distance, over the phone and by internet. This makes it an excellent tool to use at 100% by distance.

When the "DFA" is used in order to validate a company strategy or analyse customer satisfaction, the results are presented in a general graph with axes defined by the client.
Action plans are then elaborate by a team coaching or by the executive team depending on the situation and wishes of the client.

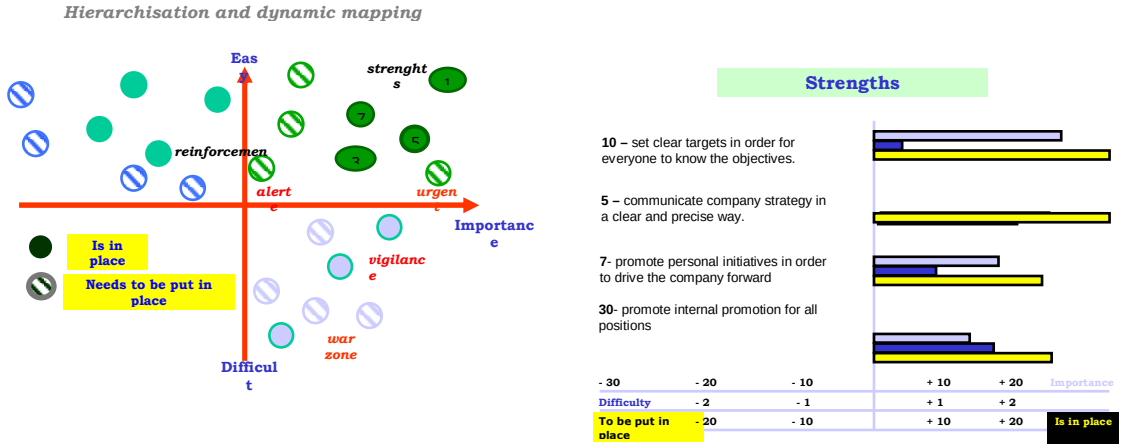

Figure 3. Some examples of customised graphs for the DFA

IV Additional facts about the DFA

1. Let's recall that in most cases, opinions or reactions differ less than the importance given to them. It is on the basis of this observation that the DFA has been developed.

   It means this is a tool particularly useful in situations where change is being implemented or where companies face difficult times during merger or the integration with another company or division. And, of course, all sorts of opinions studies can be carried out with DFA, whether internal or external to the company, and social phenomena, occurring in small or large groups can be analyzed.

2. The DFA enables people concerned by a particular problem or situation to classify all relating factors (*often greater then 40)* by order of importance : since, within the framework of any given situation, reactions or opinions can differ widely, it is important that they all be taken into consideration.
3. All analysis are made with a specific computer program. The resulting analyses are based on proven statistical methods.
4. The DFA has been awarded an international patent *(USA and EUROPE).*

5. A great amount of work, from a methodological point of view, has been done to establish the « solidity » of the underlying model. Indeed, it was important to make sure that minimal variations in the hierarchical order of preference would not result in major modifications in the structure itself of the individual set of choices (or preferences), thus altering the meaning of the results obtained.

   No tool is completely mathematical neutral. Within the scientific framework it is essential to remain attentive to this and if poorly controlled this can lead to a deviance in the results.
   The stability and the solidity of the DFA have been permanently established by a series of studies supervised by Professor Jacques Chevalier of the *Institut de Statistiques* of the *Université de Paris (ISUP).* We thank him for his personal investment and his understanding of the interest of the DFA as a powerful tool to reduce uncertainties when complex, and important human situations are studied.

Conclusion

Symatop is positioned at the cross-roads of many fields such as behavioral science, statistics and semantics. These three topics are integrated in a very subtle way and this guarantees wealth and reliability of the analyses.The DFA eliminates most of the subjectivity which exist in classic qualitative methods: it acts as a "mirror" in complex situation and objectify effect of the results presented.

> *This fact points out that the implication of the participants during the study and their adherence to the results presented are very high.*

On the whole, it gives a realistic description of the available choices: the establishment of a hierarchical structure that faithfully illustrates the complexity of individual preferences.

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A Case Study of Organizational Innovation in Taiwan's Puppet Show Industry

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Abstract : This paper considers the organizational innovation dimensions and associated factors that define Taiwan's puppet show industry. Our objective is to evaluate Taiwan's current capabilities in this area, and provide guidelines for businesses. To this end, an organizational innovation model is constructed as a foundation for innovation theory. The research methods employed in the case study include a review of the literature, in-depth interviews, and small group techniques. Based on our analytical framework, we find that organizational innovation in the puppet show industry can be divided into: (1) technical innovation, which includes product and service innovation, process innovation, and content innovation; and (2) administrative innovation, which includes staff innovation, marketing innovation, and organization structure & climate innovation. Our findings also show that the evolution of the modern puppet show in Taiwan is comprised of eight major innovative elements: dialogues, puppeteer skills, scripts, character styles, photography, aesthetics, sound effect and incidental music. The major theoretical contribution of the present study is that it supplements existing OI theory.

Key words: innovative organization, innovative management practice, organization innovation, case study

I. Introduction

Innovation has been identified as the major factor in economic growth and the expansion of wealth (EU, 1995; OECD, 1997a, b). The survival of an enterprise in the age of knowledge-based economy depends on how it improves its organizational innovation capability. Many researchers have observed that innovation is the key driver for enterprises as they strive to gain and maintain a competitive advantage (Kimberly & Evanisko, 1981; Damanpour & Evan, 1984). However, to the best of our knowledge, the question of organizational innovation in Taiwan's cultural industries, especially the puppet show industry, has not been addressed by researchers. Thus, this paper presents an in-depth case study of the context, dimensions, and other factors that influence organizational innovation (OI) in Taiwan's puppet show industry. Based on a rigorous methodology, an analytical model of organizational innovation is developed and used as the foundation of the case study. Our objective is twofold: (1) to explore the dimensions and factors that influence organizational innovation in Taiwan's puppet show industry; and (2) to construct an OI analytical model and explore the innovative activities of the industry.

II. Literature Review

What is innovation? According to Porter (1990), "Companies achieve competitive advantage through acts of innovation. They approach innovation in its broadest sense, including both new technologies and new ways of doing things." Subsequently, Betz (1997) observed that the purpose of innovation is to introduce a new or improved product, process, or service into the marketplace, while Afuah (1998) described innovation as the use of new technical and administrative knowledge to offer a new product or service to customers. In this paper, we define innovation as the creation of new products, processes, knowledge or services, using new or existing scientific or technological knowledge, which will succeed in the marketplace and provide a degree of novelty to the developer, the industrial sector, the nation, or the world.

A number of researchers have argued that it is necessary to distinguish between different types of innovation in order to understand organizations' adoption behavior and identify the determinants of their innovations (Knight, 1967; Rowe & Boise, 1974; Downs & Mohr, 1976). Of the numerous typologies of innovation proposed in the literature, we employ the concept of technical and administrative innovation (Damanpour, 1991) to study organizational innovation in Taiwan's puppet show industry. Technical innovations pertain to products, services, and production process technology; they are related to basic activities and can concern either the product or the process (Knight, 1967; Damanpour & Evan, 1984). Administrative innovations, on the other hand, involve the organizational structure and administrative processes; they are indirectly related to the basic business activities of an organization and directly related to its management (Knight, 1967; Kimberly & Evanisko, 1981; Damanpour & Evan, 1984).

The determinants of OI were the main subject of Wolfe's (1994) study and his analysis was based on an individual organization. In this study, we adopt the dual-core model (Daft, 1978) and divide OI into the dimensions of Technical Innovation (TI) and Administrative Innovation (AI). To establish the hierarchical structure and index of puppet show enterprises in Taiwan, important secondary and tertiary dimensions are resolved and classified in accordance with appropriate literature references.

Framework of the empirical study

The foundation of the OI measurement model developed in the present study is based on the OI structure factors proposed by Daft (1978), Kimberely and Evanisko (1981), Amabile (1988), Damanpour and Even (1984) ,Damanpour (1987, 1991), Schumann Prestwood, Tong, and Vanston (1994), Martinsuo and Hensman (2006). The preliminary analytical model is based on the 2004 National Survey of Taiwan's cultural industries and researchers identified (e.g. Chung, 2005), and on a study of the literature, the results of in-depth interviews with experts, as well as the use of small group techniques (SGT) to obtain opinions about the major dimensions of OI in puppet show enterprises. Following the establishment of the hierarchy, opinions about the OI hierarchical structure of Taiwan's puppet show industry were sought from five experts and scholars in order to modify the initial model and establish a more rigorous analytical structure for subsequent study. The analytical model is comprised of three levels. The first contains the system dimensions of TI and AI. The second tier has six major dimensions: product and service innovation, process innovation and content innovation for TI; and staff innovation, organization structure innovation, and sales & marketing innovation for AI. Finally, the third level contains fifteen secondary dimensions.

III. Case study: PiLi International Multimedia Company

Introduction

Hand puppet show (called "budaisi" in Chinese) was a traditional performance fevered by commons in Taiwan more than 200 years. Evolving from traditional puppet show, PiLi is a Taiwanese puppet show produced by the PiLi International Multimedia Company. Three generations of the Huang family in Yun-lin County have transformed the puppet theater from a traditional art form to an international entertainment industry. A TV series based on the show started in 1985, and continues to be one of the most popular TV shows in Taiwan. Thanks to PiLi Brothers, Chris Huang and Vincent Huang, the cable channel PiLi Puppet Theatre was launched in 1988, a channel airing the popular drama of Su Huan-chen. Unlike traditional puppet shows, the PiLi show uses state-of-the-art animation to help present scenes involving martial arts.

Innovation in the PiLi International Multimedia Company

1. Technical Innovation

(1)Product and service innovation

A. New product - new style puppets

The PiLi Puppet Theatre uses larger puppets than traditional shows and has added foot movements so that the puppets are more lifelike. The TV shows and movies feature puppets that stand 90 centimeters. Costumes remain simple, and just emphasize sex and character. Puppets can now open and close their eyes and mouths. A new type of puppet (the fourth generation) with lifelike skin will be introduced in the near further.

B. Technology development capability - fighting scenes

"PiLi" means "thunderbolt." Most audiences like the movie effects used by the PiLi Puppet Theatre. The script, editing, camera angles, and special effects are superior to the production standards of regular television shows and the budget is higher. The martial arts fighting scenes, which include sand blowing, rocks flying, explosions, special effects, video editing, and precise puppet control techniques, have transformed the puppet stars into masters of the martial arts.

(2) Process innovation

A. Machinery & equipment functions - revolutionary filming technique

Located in Yun-lin County's Hu-wei area, the three production studios of the PiLi International Multimedia Company cover over 9000 square meters and are designed solely for filming the company's puppet show. The facility is the largest puppet show production center in the world. Because of the strict production standards, equipment and filming techniques are under constant review.

B. Manufacturing process - the new platforms (carriers) of puppet show

Fifty years ago, puppet theaters only performed in villages and local temple plazas. The show was first aired on TV in 1970. After the PiLi Cable Channel began in 1988, the Huang family entered the field of film production and distribution, which led to a series of revolutionary cross-business, cross-media achievements by the PiLi Puppet Theatre. Since the release of the first PiLi Puppet Show movie "Legends of the Sacred Stone" in 2000, the performance platforms of PiLi Puppet Shows have expanded to indoor and outdoor theaters, videos, satellite TV, and opera houses.

(3) Content innovation

A. Creative scripts, new characters styles, and dialogues

There are two major innovations in the scripts: characters are extended beyond the traditional portrayal of good and evil; and the dialogues incorporate both classical Chinese language and street jargon. In addition, the humorous dialogues have become classic lines and common social languages in people's life.

B. Music and the art of vocalization

To strengthen the dramatic elements of the shows and ensure the art form is up-to-date, the Huangs discarded the traditional Nan guan music (or Southern Tones) and replaced it with pop music and newly-created theme songs. In addition, Vincent Huang's rich voice gives life to the characters such that each wooden puppet seems to have its own personality.

2. Administrative Innovation

(1) Staff innovation

A. Overall creative thinking ability

PiLi's screenwriter department was set up in 1997. It was the first establishment in Taiwan to collectively work on TV/ film scripts to meet the demands of mass production. Through their creative performances and skillful management, the Huang brothers continue to find new ways to develop hand puppet shows.

B. Overall creativity intention

The Huangs' business philosophy can be summed up as follows: "Everything should be innovative, and we should pursue perfection under complex circumstances; otherwise, the business will decline."

(2) Marketing innovation

A. Market orientated strategic planning

The PiLi International Multimedia Company has marketing agreements with 7-11, a chain of convenience stores, and several merchandise licensing partners. Cross-country co-production and joint ventures with different media outlets have become the main strategies for expanding into overseas markets, and raising the international profile of the brand and the company.

B. Interactive marketing

PiLi Multimedia International uses the Internet, on-line games and its own Website to communicate with younger people. The company pays a great deal of attention to the suggestions of fans, who have established their own club. By updating the traditional art form, the Huangs have been able to expand its fan base.

(3) Organization structure & climate innovation

To change the theater troupe's management into corporate management, the Huangs set up a production center and commenced mass production of PiLi's products.

IV. Conclusion

We have established an analytical OI model of puppet show enterprises in Taiwan using a rigorous method that involved continuous challenges and modifications. The method combines the concepts of process theory and organizational innovation. The major theoretical contribution of the present study is that it supplements existing OI theory. The dimensions and indicators, especially the additional content dimensions and the platforms (carriers) secondary dimensions, used to evaluate the OI of puppet show enterprises not only explain the context of OI, but also form a platform for studying the OI measurement model and its applications in cultural industry. Based on our analytical framework, organizational innovation in the puppet show industry can be divided into: (1) technical innovation, which includes product and service innovation, process innovation, and content innovation; and (2) administrative innovation, which includes staff innovation, marketing innovation, and organization structure & climate innovation. Our findings also show that the PiLi Puppet Theatre is comprised of eight major innovative elements: dialogues, puppeteer skills, scripts, character styles, photography, aesthetics, sound effect and incidental music (the music is divided into character music, scene music, and emotional music). With such a broad reach, solid foundation in performances and efforts in developing creativity, it does not seem difficult for PiLi to start a revolution.

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A Framework for Potential Role of Information Specialists as Change Agents in Performance Management

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Abstract:

This paper aims to explore the changing role of the Information Specialist (ISp) in the implementation of business performance improvement through business process re-engineering (BPR) initiatives. The paper will begin by examining the evolution of BPR and then discuss the changing role of the ISp. Technology enabled Performance Management (PM) and its strategic implications would be key to measuring the effectiveness of BPR and the role of the ISp is a vital part of this. Through a literature review and case based empirical evidence, a conceptual framework has developed to appraise the role of the ISp.

Keywords: Performance Management, Business Process Reengineering, Information Specialists, Information Systems

I. Introduction

BPR can be defined as the "fundamental rethinking and radical redesign of business processes to achieve an improvement in critical, contemporary measures of performance, such as cost, quality, service or speed (Hammer & Champy, 1993).Slack et al (2004) also refer to it as breakthrough or innovation based improvement which invariably is described as technology orientated. BPR was very popular in the early 1990's during a climate of recession and downsizing as an opportunity to streamline processes and cut cost. A study of over 100 re-engineering projects by Hall et al (1993) found that the failure rate was about two thirds. Al Mashari et al (2001) concede that BPR has lost favour but their research concluded that most organisations knowingly or not are involved in BPR and that the success rate is more favourable at around fifty five present. Perhaps the reason for many of the failures could be to do with the mechanistic interpretation of BPR by the key theorists Irani et al (2000). As a consequence of this, many BPR proponents engaged in a period of soul searching and embraced the emerging technology of Enterprise Resource Planning (ERP) software as a vehicle for implementing BPR Hayes et al (2005). The paper explores the evolving role of the ISp in performance improvement initiatives such as BPR. This paper considers ISps to be individuals employed to provide professional expertise in delivering solutions to corporate information needs and to help monitor organisational performance.

In such an environment the IT/IS department will be required to continually supply new deliverables, including wider information provision through adoption of appropriate software and hardware and systems maintenance and upgrades. In particular the IT/IS department is usually expected to resolve the issues of how the problems of legacy systems will be overcome. These can restrict BPR projects because of a lack of connectivity between functionally designed systems and their data models, but as they usually represent years of development the legacy systems often cannot be as easily replaced as Hammer's "Don't Automate, Obliterate" rhetoric might suggest (Earl & Khan 1994). Similarly, Love (2004) insist a need for improved IS evaluation due to the complex nature of IS/IT together with "uncertainty and unpredictability associated with its benefits.

The role of IT and successful performance improvement of BPR initiatives can be crucial to the organisation's performance. Bititci et al (2002) conducted research on web enabled performance measurement systems and concluded that if properly implemented, such systems would promote a proactive management style and greater confidence in management decisions. The relative effectiveness of the ISp within organisations can follow a similar continuum to the four stage operation model developed by Hayes and Wheelwright (1984). This model originally applied to the operations function which charts the function's contribution to

organisational effectiveness from essentially a reactionary role to redefining the industry's expectations.

Innovative IT solutions coupled with the growth of the internet have resulted in the creation of new business models, Timmers (2000). IT impacts on organizations in three ways: automating existing business processes, outsourcing and vertical integration opportunities and the creation of new business models that engage the customer. Neely (1999) believes IT to be a key driver behind performance measurement development which can facilitate data collection, analysis and presentation. Markovic and Vukovic (2006) put forward a five step plan which inextricably links future strategy development and subsequent performance management with IT.

The emerging opportunities from IT based technology has led to organizations transforming their relationships with other organizations within the value network, (Johnson et al 2005). This has led to compelling arguments for a board room presence for the IT specialist. The term Chief Information Officer (CIO) was coined by Gruber (1986 cited in Hayes et al 2005) to co-ordinate the IT strategy across functions. Since that time new opportunities emerging from ERP software and the internet provides further justification for a CIO to co-ordinate the activities inside the organization and within the value network, Hayes et al (2005).

II. Research background

A review of existing literature in the area of BPR and Information Management reveals a lack of consensus amongst researchers concerning the appropriate role for ISps during and after BPR. Opinion is divided as to whether IS professionals should reactively support BPR or whether IT/IS developments should be driving these initiatives. A questionnaire based 'Descriptive Survey' with 60 respondents is used as a first stage of primary data gathering. This is followed by follow-up interviews with 20 of the participating organisations to gather further information on their experiences. The final stage of data collection consists of further in-depth interviews with four case study companies to provide an even richer picture of their experiences.

III. Summary of Findings

The questionnaire responses indicated that the role of the ISp prior to performance improvement programmes was that of a support function, managing the IT requirements of the organisation, whereas during BPR, there was a need for ISps to gain a greater understanding the information requirements of the organisation and its new processes. The ISp role was to be involved at the start of the BPR programme, whilst not leading or owning it. The follow-up interviews pointed to the possibility of the 'hybrid' ISp, a professional being business-aware and IT-literate, and in some cases acting as a catalyst for future change. This supports the argument by Gruber for the role of a CIO (1986 cited in Hayes et al 2005).

The Case Studies have confirmed that the prior to performance improvement initiatives the role of the ISp in the case study organisations was a technical support function. This matured during BPR, to a role that was key in helping to identify processes for redesign and helping to redesign them with the capabilities of IT in mind. These case studies have further indicated that subsequent to BPR organisations perceive the need for a much more business-driven role for the ISp, adding value to the organisation and increasing the benefits of process redesign. Results clearly indicate that the success of the BPR initiatives is dependent on effective performance management and knowledge sharing which aligns with the corporate strategy.

In some cases ISps have been very much involved in change teams, liaising with other business professionals to drive requirements and to set expectations. A model has been created to illustrate how organisations considering change programmes might adopt best practice and successfully development the role on the basis of the experience of the organisations involved in this research.

IV. Conclusion

The specific aim of the paper was to investigate the role of ISp as a change agent of business improvement initiatives such as BPR and to test the proposition that the role of the ISp in BPR initiatives and resultant process oriented organisations is different from that of the traditional IT/IS technical specialist. IT enabled performance management and its strategic implications would be key to measuring the effectiveness of BPR and the role of the ISp is an vital part of this. In particular, evidence has been sought to test the theory that in process oriented organisations ISps play a wider, more pro-active and more business oriented role than previously.

The research has provided detailed empirical investigations into the actual experiences of organisations that have undertaken BPR as performance improvement initiatives. It also suggests a reference framework which companies might use in considering their future use of ISps. In addition, post-BPR the ISp's role as a business-aware and IT-literate 'hybrid' emerged as a strong theme in the research. The future ISps needs to cater for the more complex information requirements of cross-functional and extra-organisational processes. The organisation's surveyed postulated that the ISps role will develop still further, suggesting the ISp will become a catalyst for change, using IT to add more value to a more customer-focused business. The suggestion was also that increasingly mobile workforces and dependency on outsourced operations or the services of ISPs would enable the organisation to focus on its core business. IT/IS and Performance Management initiatives should be aligned with the implementation of corporate strategy and appropriate IT enabled performance metrics.

Whatever the future ISp is called, the role will be the same: to facilitate performance improvement through IT, and hence an understanding of the key and fundamental needs of the business is increasingly paramount. Measuring this added value will be complex will again place new demands on ISp. These authors suggest that ISps will more and more need to understand and communicate the increased value to be gained from the deployment of IT.

Change programmes will be business-led, and increasingly supported by a 'hybrid' professional, who is technology- and IS-aware, whilst also understanding the needs and expectations of the business. In addition to supporting change programmes such as BPR, those organisations surveyed suggested that the ISp will in fact become a 'catalyst' for change, using IT to add value to the business. The role will be more 'customer-driven'. In order to fulfil this role, performance measurement needs to be at the heart of the ISp role. Some organisations believe this will also include the needs of the new mobile work force, and involvement in outsourcing programmes.

The ISp has been found to be an essential participant in BPR projects. The organisation must be made aware of the capabilities of technology as an enabler of new process designs, and it is essential that an understanding of current IT is represented within the BPR team. In order to judge the effectiveness of the BPR implementation, appropriate IT enabled performance metrics need to be developed which can facilitate effective data collection, analysis and presentation.

This new role of the ISp, to be more aligned with the business and to become far more customer focused. This shows how the new role encompasses not just the primary activities, but the support activities of an organisation as well. Information management across all functions has been shown by this research to be a key deliverable of the IS infrastructure during and after BPR, as the traditionally isolated and insular processes within the organisations become cross-functional and open. Information sharing is essential. The role of the ISp has thus evolved to encapsulate the business needs of the organisation, and become a change agent, enabling this new way of working with the dual focus of information technology and the needs of the business. It is now appropriate to consider the impacts of these findings in two ways. Firstly, the extent to which they are consistent with or contradictory of previous published work is of interest, especially to business academics. Secondly, the relevance of the findings to practitioners in the future recruitment and deployment of ISps is a matter worthy of comment.

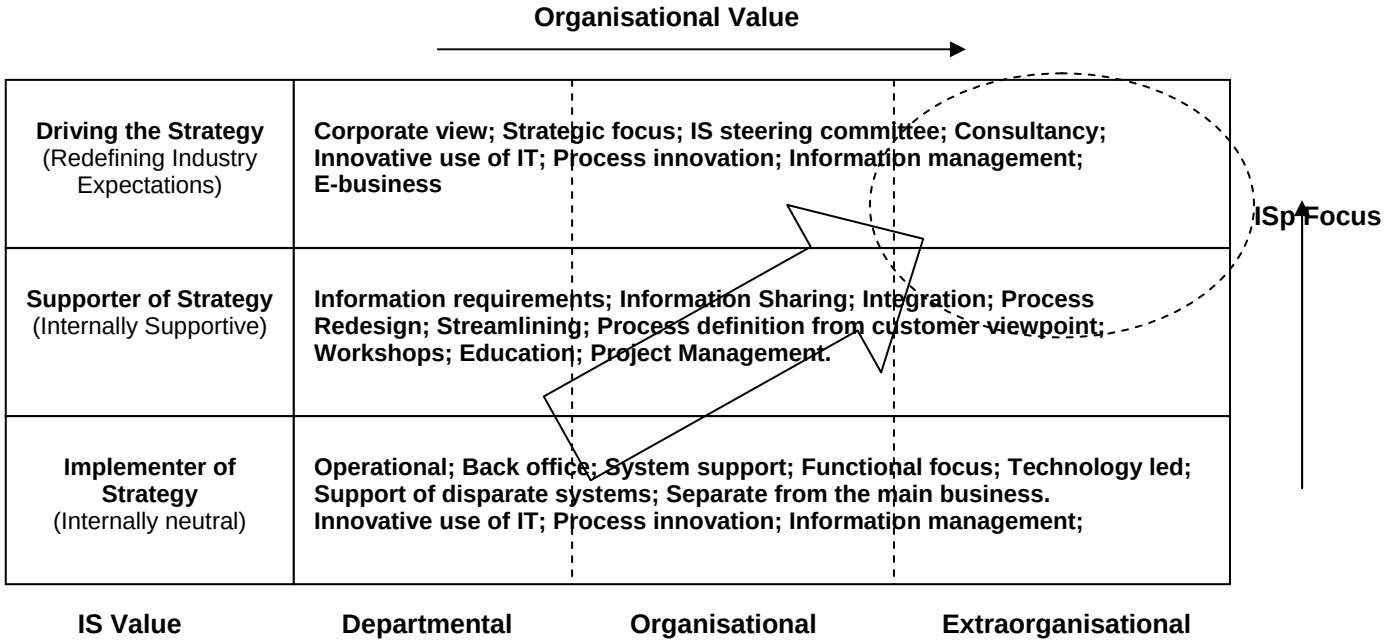

Figure 1. ISp Strategic Engagement Matrix

(Adapted from Hayes & Wheelwright (1984)

This evolution of the ISp follows the path from being a reactive internally neutral approach to a proactive role which underpins the organisation's competitive advantage. Our model (Figure 1) highlights the ISp focus and the corresponding organisational value. The model shows that the traditional role of the ISp is shifting from a functionally based role and focused on the implementation of strategy to a strategic role which is not only organisational wide but can link outside the organisation to other organisations within the supply chain or value network. The relevance to practitioners is that it demonstrates the importance of the ISp in influencing and driving strategies which involve process reorientation. However without effective performance management the effectiveness of the change and the satisfaction of strategic goals will be difficult to appraise.

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Economic and environmental performance of the food industry

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Abstract: Achieving synergy between the economic and environmental performance of food production systems is an important step towards innovative operations and competitive advantages. We argue that interdisciplinary research that uses operations research techniques, operations management insights, food process technology and product design helps in exploring the effect of uncertainty in demand and production. As a result, process design can be more robust: both economic and environmental. This position paper sketches the problem and the main elements of the proposed approach.

Keywords: food production; sustainability; product design; process design

I. Introduction

Over the last years, sustainability and sustainable operations have been put on the agenda of industry, research, and government. Kleindorfer et al. (2005) consider sustainable operations as one of the key topics in Operations Management and Operations Research (OM/OR) research. Most of this research so far has been done in the context of discrete manufacturing and deals among others with remanufacturing, closed loop supply chains, and improving supply, but has ignored sustainability in process and food-processing industries (e.g., Flapper et al., 2002, French and LaForge, 2006). Within industry, many initiatives have been taken to reduce energy consumption, reduce waste, increase health and safety, etc. This often includes use of the ISO 14001 standard, a widely implemented environmental management standard (ISO, 2004, Kitazawa and Sarkis, 2000).

The development towards sustainability is also known as triple-bottom-line thinking, explained by Kleindorfer et al. (2005) as: 'integrating profit, people, and planet in the company's culture, strategy, and operations'. The main point being that profitability is only one aspect in performance measurement for firms. Theoretically, this seems to result in a trade-off between economic results and environmental results, as environmentally friendly production could be expected to increase production cost. But, as Porter and Van der Linde (1995) argue, in practice this situation can lead to innovative solutions that enhance resource productivity. An important aspect of their argument is that reducing pollution is also reducing valuable waste. Although these arguments are already a decade old, this synergy between economic and environmental performance has not yet been achieved (Kleindorfer et al., 2005), and is still debated in the literature (e.g., Ambec and Barla, 2005).

Realizing synergies between economic and environmental performance likely depends on industry-specific characteristics (Karagozoglu and Lindell, 2000). So far, research in sustainable operations has been focusing on discrete industries investigating such issues as modularity, remanufacturing, waste minimization, reuse of parts, and design for disassembly without paying much attention to other types of industries and their typical characteristics. Here, we focus on the food industry as using often expensive, natural resources, and as being the largest manufacturing sector in the European Union (CIAA, 2005). The use of natural resources especially makes waste reduction an important aspect of sustainable production. Even more interesting is that this industry can be characterised as having a high level of expensive equipment and a high level of introduction of new products accompanied by a large uncertainty in volume and mix of demand. Due to these factors, the sustainable operation of food production systems is under heavy pressure. The main purpose of this paper is therefore to explore how the economic and environmental performance of the food industry can be improved. We present an approach that enables food companies to explore the effect of

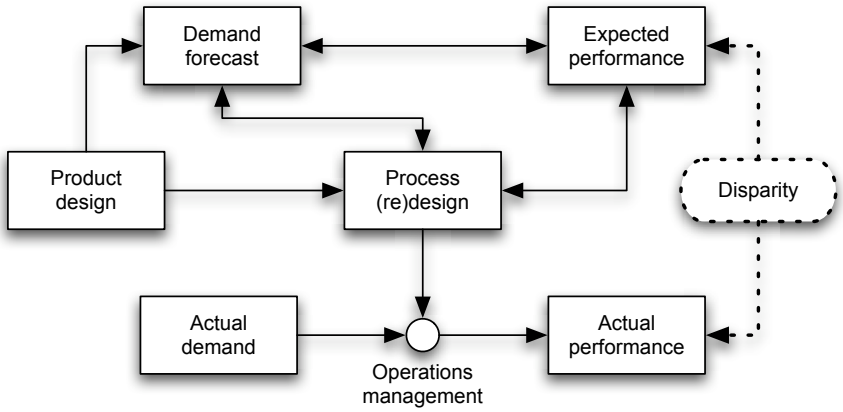

Figure 1. Performance implications of product and process design.

different scenarios for their production system performance, with a specific focus on uncertainty with regard to demand.

II. Background: sustainability and food industry

Sustainability has been approached from different, often isolated, angles: e.g. being a technological, psychological or quality problem. In order to reach both economic and environmental improvements, more innovative and fundamental improvements are required. An interdisciplinary approach, combining operations management insights with technological expertise is necessary, as was recently argued in both the operations management community (Corbett and Klassen, 2006), as well as the engineering community (Azapagic et al. 2006, Edwards, 2006). Such an interdisciplinary approach can support the development of models and tools for use in the industry. This innovative knowledge creation would be a significant contribution to the sustainability of future production systems.

In the food industry, next to economic performance, environmental performance has been a main issue for several decades (CIAA, 2002). Recent studies in the European Union (Dobson *et al.*, 2001) report that environmental performance is also increasingly important in gaining a competitive advantage. The European Union's Lisbon Strategy even sees this as a prerequisite for lasting success of improved competitiveness (Commission of the European Communities, 2005). Significant improvements have often been made in this area, but mostly very specific for one production site, a certain product, or a specific process.

One of the typical characteristics of food-processing industries is that recipes are closely related to plant and machine design. The order and type of operations on a product influences the quality of products. Also, the introduction of new products/recipes is one of the major challenges. It is not possible to built new product lines for each new recipe, so these situations normally result in more complex management of operational and environmental aspects. In the last decade, most food-processing companies have seen a significant increase in the amount of products/recipes. And more often than not, the underlying production process/plant design has not changed, but is often adapted by adding some equipment.

This results in an increasing unbalance between products and processes, leading to production inefficiencies (on several levels: product wastes, capacity utilization, manpower utilization, etc.) and decreased supply chain performance (Shah, 2005). Product design and process design have a central role in the actual performance of production systems, which is illustrated in Figure 1. The unbalance between the product mix for which the production process was initially designed and the (highly volatile) product mix that is actually produced leads to a situation in which expected performance and actual performance differ significantly. According to Vachon and Klassen (2006), the current unbalance between products and processes can be partly

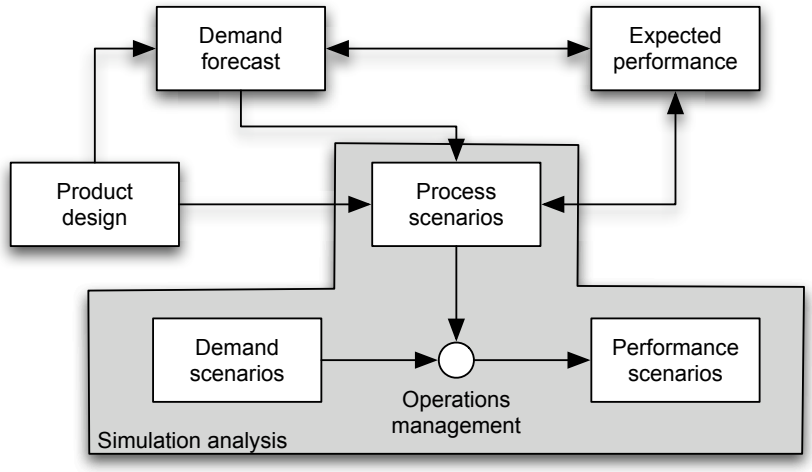

Figure 2. Proposed research framework for simulation analysis.

attributed to the fact that different parties within a supply chain are involved in product design and process design. These effects are extremely important in case of, for instance, new product introductions, but have hardly been considered in the literature (Lu and Wood, 2006).

III. Scenario-based simulation approach

In order to deal with the problems described in the previous sections, we propose a research direction that can lead to innovative and sustainable improvement of food production systems (in terms of economic and environmental performance). Starting with the situation illustrated in Figure 1, we believe tools can be developed to gain more insight into the relationship between process design and operations management on the one hand and the demand characteristics and resulting performance on the other hand. Figure 2 shows our proposed research framework. The grey-outlined part of the framework covers the concepts that are relevant in the development of simulation tools. Development of tools can range from custom-made software to simple spreadsheet models. What is important is that these tools can then be used to analyse various scenarios for e.g. process designs, operations management strategies, and future product mixes (demand).

The interdisciplinary setting is of the utmost importance: both technological and managerial aspects should be considered in the development of models and tools and the design of scenarios. For the development of models, this means the need for in-depth knowledge on e.g. detailed process characteristics from process technologists, planning and scheduling procedures from production managers, and demand behaviour from the sales department. Combined with a thorough analysis of available production data sources, this leads to models that are usable for detailed scenario analysis. In the design of scenarios, the detailed analysis of existing process and demand characteristics provides a starting point from which it is possible to develop new scenarios. The performance measures used in these tools can and should cover both economic and environmental aspects.

This approach provides the possibilities to design robust production processes, and robust operations management methods. Overall, it should lead to the development of new theoretical and practical models and insights into (i) the relationship between product and process design and (ii) the synergies (or trade-offs) between economic and environmental performance of production systems in the food industry. It is important to note that the proposed research methodology includes the use of case research. By itself, these cases can already be very valuable in applied research (Lyons, 2005), but over time, these cases can contribute to a sound theory-building process. Therefore, they should cover a wide range of process types

(theoretical sampling), which provides the means for generalisation to build valid theory and models suitable for the whole industry (Eisenhardt, 1989).

This approach is inspired by a research project by Akkerman and Van Donk (2006), in which a case study was performed and a decision support tool was developed. Their study can be seen as an illustration of the approach presented in this paper. Their decision support tool aimed to support process design and production planning decision making in light of the reduction of product losses (economically and environmentally interesting!). Various scenarios were studied, using a spreadsheet simulation model. The study demonstrates (i) that the approach is able to reduce the product losses significantly, and (ii) that simulation tools can be very helpful in understanding the complex dynamics found in real-life production systems.

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Needs for methods and models rationalizing work of the actors of an organization implied in an innovation process: basic principles and examples

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Abstract: The processes of innovation can be considered before all as business processes; those generally relate to more or less complex organizations. It is possible to understand and improve these processes by exploiting methods and models coming from various fields. Basic principles and examples are provided in the article.

Keywords: innovation process, innovative services and processes, models, innovative organization modelling, tools.

I. Introduction

The innovation is a wide, rich and multi-disciplinary field, which made the object of many studies and works, studying the innovation according to various points of view: institutional, scientific, organisational, … (Hage and Meeus, 2006 ; Allen and Henn, 2006). We are interested in it under the angle of organization modelling, with an aim of improving the effectiveness of the actors of the organization, and of integrating in this one assistance systems (relating for example to economic intelligence). One can note that economic intelligence and innovation are closely dependent (MEDEF, 2006). Indeed, if one refers to success key stages of an innovation approach[1]: (1) to find and conceive the innovation (to analyze the innovation potential, to define a strategy, to inform themselves on technologies, the markets, concurrence, to seek the financings, to find solutions, to reinforce the potential of innovation, to innovate in partnership), (2) to evaluate the innovation (to check the freedom of exploitation, to integrate the standards and laws, to respect the environment, to study technical feasibility, to validate the assumption of market), (3) to develop the innovation (to ensure the viability of the innovation, to use technology transfers, to ensure the financing of the innovation, to establish a plan of development, to create an innovating company, to set up a technological watch), it proves that tools coming from the economic intelligence can be of a capital contribution. Let us note that in the processes of innovation, we include the study and proposition of innovative processes, i.e. those profiting from an innovation, coming for new solutions or new services. For example, in the hospital field, new innovating processes appear ; they tie profit of new information technologies: actors of the organization can be seen like nomadic users of new devices likely to help them in their activities; however new problems appear, it is important to identify and to solve them (Beuscart-Zéphir et al., 2005). Actually, when the global approach used is participative, processes of innovation and innovative processes are or must be closely dependent.

The article is first focussed on analysis, modelling and simulation of organizations implied in such processes, these processes being seen as business processes (under the angle of the quality standard ISO 9000, generation 2000, cf. Mathieu, 2002). Then, we highlight a whole of ideas related to models issued from multi-agent systems.

II. Analysis, modelling and simulation of organizations implied in innovation processes

The human factors play an essential part in the effectiveness of the innovation processes in companies. The majority of the human organizations committed in such processes are based on

[1] Selon : http://www.dijon.cci.fr/fr/entreprises-developpement/developpement-3050.jsp

creation, handling and exchanges of information, knowledge and documents (numerical, paper…) between actors constituting the organization. The emergence of new technologies and powerful, simple computerized tools often contrasts with the lack of methods for implement and integrate them in the concerned organization. In addition, according to Adam et al. (1998), if solutions are sometimes found to solve local problems of generally technical nature, it does not exist systematic ways to solve complex organisational problems where the human factors are critical.

The analysis, modelling and simulation of organization (according to static and dynamic aspects), figure 1, often makes it possible to identify factors of blocking, errors, waste of time, and so on. Initially, the analysis must allow, after identification of the principal objectives of the organization, to specify the role of the various actors and to describe the tasks assigned with each role. The analysis of the external interfaces must be also carried out in order to identify the inputs and outputs of the organization, for example the interaction links with the suppliers, the customers or other organizations. As regards modelling, numerous models, coming mainly from Software Engineering (UML models, SADT actigrams …) or derived from existing models, can be very efficient (Bernonville et al., 2005). The selected models must for example reflect the importance of the data in the human organization, to be able to underline the points/places of communication and co-operation. They will have to be presented at the actors, in order to propose in a participative way one or several computerized solutions as well as solutions related to the organization itself. Simulation must then play a major role, by exploiting the potentialities of the selected models. For example, the simulation based on the use of Petri Nets can make it possible to model the interactions between actors finely and to highlight possible improvements concerning them: during a study concerning organizations engaged in innovation processes in a large company, simulations have led to decrease several weeks of the durations of certain processes related to industrial patents (Adam, 2000). In the healthcare field, and particularly in projects concerning integration of new interactive systems in the process of therapeutic prescription, the use of UML activity enabled us early in the project to highlight important differences in the role of the nurses, and thus to identify potential problems of co-operation between various actors of this process (Beuscart-Zéphir et al., 2005 ; Kolski and Bernonville, 2006). This global approach goes in the same direction as the quality standard ISO 9000, generation 2000, recommending the improvement of the whole of the processes in companies.

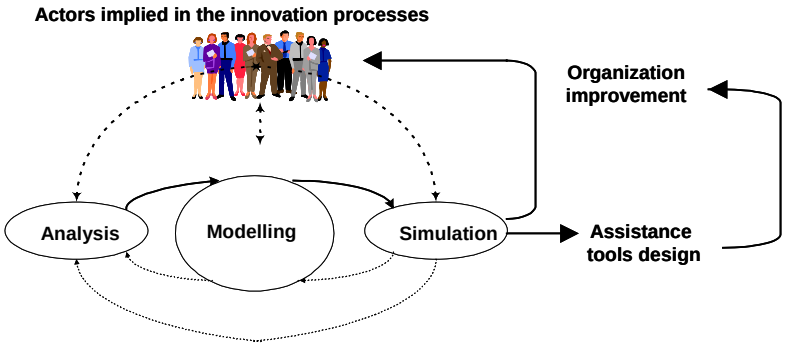

Figure 1. Global principle of organization analysis, modelling and simulation

III. Modelling of organization for the innovation: potential contribution of agent oriented and holonic models

The comprehension and the improvement of the innovation processes in the companies are in our opinion dependent on the description and the study of the organizations. We think that the multi-agent systems research field can propose promising solutions for such studies (Mandiau et al., 2002 ; Boissier et al., 2005). In particular, the organizations can be defined like a whole of roles concerning the various actors and their interactions. While being based on the concept of agent and by generalizing an organization like being able to integrate human agents as well as software agents, it seems that two possible axes can bring methodological elements to the study and global comprehension of such systems.

The first axis consists in proposing role plays where various actors try to explain their steps of decision-making in order to improve reciprocal comprehension of the objectives of each one for a better convergence of the decisions and working methods. Of these role plays, conflict situations can thus be highlighted and then solved; new ideas can appear with respect to the functions, tasks or constraints associated with each role (of oneself and others in the organization). For example, works of (Guyot and Shinichi, 2006) proposes situations applied to processes in company or operations of collective behaviors ; see also (Hamel, 2006). In the same way, the CIRAD (cf. http://cormas.cirad.fr/en/demarch/demarch.htm) carries out a similar work for human organizations in developing countries ; the objective is to improve their effectiveness by (1) identifying and discussing problems without inhibition due to the hierarchy because of presence in a game, (2) by giving an outline of the global vision (non-existent in the reality because for example of the ignorance of the total functioning of their environment). We think that such steps can bring a new glance on the improvement of the innovation processes, but our research does not relate to this axis.

The second axis consists in the analysis and the improvement of the existing organisational structures. The multi-agent systems research field is interested in it particularly under the angle of the multi-agent organizations. Within this framework, works on the modelling of holonic systems (which can be seen as particular multi-agent systems) can bring interesting contributions and points of view. Holonic systems were proposed by Arthur Koestler around 40 years ago (Koestler, 1969). The underlying principle is the fact that, in real life, an entity must be considered both as a whole made up of other entities and as being part of a set. Koestler's ideas have already been applied in various fields, notably in Intelligent Manufacturing Systems (in order to form one of the models on which the factory of the future could be built), robotics, transport planning, cognitive psychology, and so on. A Holon is defined by Koestler as being a part of a whole or of a larger organization, rigorously meeting three conditions: to be stable, to have a capacity for autonomy and to be capable of cooperating. Several conferences are now dedicated to such new multi-agent and holonic systems and organizations, see for instance (Marik et al., 2005). We have exploited the holonic concepts for holonic modelling of organizations implied in innovation processes; the application field concerned patent rights in the chemical domain (Adam, 2000 ; Adam et al., 2001) ; the objective was to provide the actors of the organization with computerized tools adapted to their tasks (Adam and Lecomte, 2003 ; Adam and Mandiau, 2005).

Conclusion

For the understanding and the improvement of innovation processes, the use of adapted methods and models prove to be necessary. The Software Engineering and the Distributed Artificial Intelligence (Systems multi-agents) fields offer a whole of possibilities on this subject; in fact it is possible to exploit directly or to adapt some of them. We used and/or adapted several models in various fields (implying complex organizations) in connection with innovation or innovative processes. Our research perspectives relate to the study of new models and methods and their application in various application domains.

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Service orientation for manufacturing firms: Challenges and innovation management

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I. Introduction

Commercial services are still increasing their importance in the national economy whereas the proportion relative to industry continues to decrease as well as the number of employees concerned. Several justifications can be found to explain this established fact such as enhancement of productivity in industry, loss of competitiveness regarding the foreign industry, policies of externalisation of operational services implemented by companies… As a consequence, several problematic rose:

- For service providers because the new market trend imposes, on the one hand to industrialise services and, on the other to develop innovations. Some topics such as the development of strategic management tools that would take into account set up and management of changes as well as operation and human resources management merge and join the previous one concerning marketing, customer relationship management, service delivery system, service quality and price fixing [Tannery, 2001].
- For manufacturing firms because a way to survive in this context is to innovate by the way of service i.e. to follow a service orientation. The objective is to associate to the product added value, a customer added value by the furniture of a set tangible/intangible or product and product service. Among the possibilities to propose such an offer, firms can choose between specialisation and diversification. These strategies that can be matched on the long term need to be implemented step by step to guarantee a successful service orientation while taking account of their proper prerequisites and constraints.

Here we focus on manufacturing firms problematic and more precisely on the different elements that should be examined while trying to follow a service orientation. After a short presentation of the service orientation ins and out, we present some tracks that should be examined to determine the profitability to follow a service orientations. All those points will be developed in our final contribution.

II. Service orientation

1. Assumptions

We assume that goods and services are not exclusive and can be twin vision of a same object and components of a whole whose dominant is service oriented. In the following, we will use the term of *'product'* for the couple (*material*, *service*) and *'basic service'* for the delivered service (see figure 1).

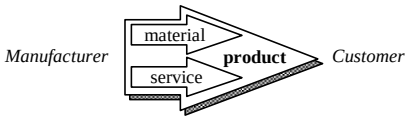

Figure 1: Product representation

The definitions of specialisation and diversification we used are those classically stated in the literature. The specialisation strategy consists for a firm to focus on only one activity domain in order to master it and to acquire specific skills and experiences (core competencies paradigm).
The diversification strategy consists for a firm to create or acquire new activities, or to extend existing one to others geographical areas in order: to share exploitation risks, to take new risks and take advantages of opportunities and eventually synergies or to compensate a decline of activity profitability, market and skill. Diversification can be split in two types:

- An external diversification that consists in the acquisition of firms belonging to others activity area or to different geographical market (enterprise network paradigm),
- An internal diversification that concern the development of new activities or the research of new areas by the firm itself (enterprise positioning problematic).

2. Innovation within service orientation

Innovation that can be integrated in a service orientation concern: studies tests and activities of before sale, personalization and product adaptation, global offer and master of work, delivery logistic and installation, technical documentation and formation, repairing and maintenance, technical assistance, payment facilities and financing credits, insurance and warranty extension, materiel lending or renting, repurchase of materiel, reduction of the deadlines and choice of the delivery date, satisfaction vs. reimbursement [Alix, 2006]. As we can see, those innovations intervene at different stages in the product life cycle and mainly concern the commercial, design, maintenance, and logistic functions. According to some reports published by the national institute of statistics and economic studies (INSEE), manufacturing firms already purchase to the service industry some production support services such as purchasing, maintenance, logistic, central administration … Innocently, considering on the one hand, the functions concerned by the potential innovations and on the other, the way of doing of firms, some innovations should logically be realised inside the considered firm (ie. concerning the commercial and design aspects) while others should be bought externally to service providers. Implications concerning the organisation required to support them are then quite different. In the first case, the two strategies of specialisation and internal diversification can be set up, depending on the firm long term objectives whereas the second case implies an external diversification. But obviously a service innovation has also strategic implications that should be taken into account to define the profitability degree of such an orientation [Van Looy, 1998].

III. Implications of a service orientation

1. Basic implications

Implications of a service innovation are:

- Strategic due to the necessity of defining common organisation, management and control principles,
- Marketing due to the necessity to analyse and understand, rapidly and efficiently, customers requirement to provide the good service, at the right time, right place,
- Commercial due to the necessity to determine the differentiation in order to push the offer toward the customer,
- Economical due to the discourse transposition that should be less technologies and product functionalities oriented but rather additional service and customers benefits oriented,
- Cultural due to the modifications of firm employee's skills and domain of interest that should be less back office and more front office.

2. Profitability problems

Actually, the main element that put a brake to the development of services furniture by industry is service costing and price fixing. According to Baglin, only 31% of them are sold whereas their cost can be important due to the skills and/or material required to perform them [Baglin, 2004]. Furthermore, the return on investment is difficult to evaluate because even if they can enhance customer's attractiveness on the long term, the financial benefits are neither systematic nor direct.

Another element is that, often used as tool for differentiation regarding competitors, services must be particularized to the customer and are subjected to demand fluctuations. This has consequences on the quality of the service, the relationship with the customer, the service delivery system and the delimitation of the offer structure. Interdependent, those four elements make the profitability of the service orientation unsettled [Norman, 1993], [Gronroos, 2000].

IV. List of points to examine before following a service orientation

Considering the above-mentioned implications and problems, we have identified questions that should be answered while trying to innovate by the way of service. Some of these questions classified by thematic, as well as some analysis starting point and consequences of the potential choice are listed below.

1. global strategy thematic

Which organisation to set up and for which service orientation?

We consider that three orientations are possible:
- The smooth service orientation that consists in delivering only support services built around the product. The goal is to reinforce and increase the value of the industrial offer. This can be profitable for firms if the product provided can justify itself its differentiation toward concurrency thanks to individual satisfaction criteria, and if the costs associated to the support services are integrated in the offer final cost.
- The strong service orientation consists in providing additional complementary services via a service offer that can be self-sufficient and independent from the industrial production activity. The coupling will lead to the definition of new production or servuction processes, the development of new skills because of these new processes. In this scope, manufacturing firms will have to determine the best strategy between specialisation and diversification, a deep reorganisation of the firm and the creation of new profit centres.
- The medium service orientation rest on the furniture of a set (product + support service + additional complementary service) that will not deeply modify enterprise organisation and that could satisfy most of the customers, at a lower cost.

Analysis starting point
- The firm: know how, skill, renown, activity domain, organisation model…
- The links between the service orientation degree and the strategies of specialisation/diversification,
- The surrounding economical partners and the difficulties/facilities to set up the different strategies.
- The marketing strategy
- …

Potential consequences
- Questioning of the firm organisation model (ford model, cooperative/hierarchical model, and project model [Bercot, 2005]) and borders,
- New valorisation of firm functions
- New definition of working process
- …

2. Marketing thematic

Which offer and which decision variables for these offers?

The objective is to respond to the customer requirements and to satisfy the objectives of quality, and profitability.

Analysis starting point
- The threats and opportunities, forces and weaknesses of the enterprise products portfolio,
- The market analysis on customers' requirements to identify the enterprise target in terms of potential complementary services to deliver,
- The concurrency environment analysis to study the behaviour of each concurrent company and of each concurrent offer and their respective performances,
- The study of the available means to reduce the space of the coupling possibilities.

Potential consequences
- Delimitation of the each firm free decisional space to support the global strategy thematic,
- Definition of the decision variable (offer price, quantity…) and means to support offer operationality.
- …

3. Selling thematic

How to sell according to which price and which quantity? How to manage the customer relationship?

The objective is to determine the selling force required taking into account the profitability expected and the positioning desired.

Analysis starting point
- The mix marketing analysis,
- The global offer real cost and the ratio offer/demand,
- The means available to support the offer spreading,
- The service real usefulness for the customer and for the firm
- The return on investment variables and of the service profitability conditions
- …

Potential consequences
- Determination of the amount of resources required to push the global offer,
- Determination of the demand fluctuation,
- Determination of the customer relationship management parameters,
- Determination of the communication protocols,
- ...

4. Service engineering thematic: design/production

How to design the service offer? How to follow the continuum service personalisation while industrialising the production?

The goal is to determine how to make the offer tangible.

Analysis starting point
- The physical production means and the technical and human resources
- The offer definition
- …

Potential consequences
- Identification of the production procedure and process to set up,
- Synchronisation between resource, space and time,
- Definition of indicators and metrics to measure the expected functional objectives and the customer satisfaction,
- ...

V. Conclusion

Here are proposed some tracks that managers of manufacturing firms willing to innovate by a service orientation should examine. Thematic such as (e)distribution, yield management… should be completed and developed as well as analysis starting point and potential consequences. The design of the network of enterprise that is necessary to support the service innovation in the case of external diversification will be emphasised in the final paper. The final objective of our works is to identify a decision framework (i.e. decision variables, constraints and criteria according to objectives) that could support a service orientation thought.

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The TRIZ-CBR synergy: a knowledge based innovation process

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Abstract: This paper presents a synergy between the Theory of Inventive Problem Solving (TRIZ) and the Case-Based Reasoning (CBR) approach for problem solving, to support creative engineering design. This synergy is based on the strong link between knowledge and action. In this link, TRIZ offers several concepts and tools to facilitate concept creation and to solve problems, and the CBR process a framework capable to store and reuse knowledge with the aim to accelerate the innovation process.

Keywords: TRIZ, Case-Based Reasoning, Innovation, Contradiction matrix.

I. Introduction

According to Smith (Smith 2005), innovation's outcome depends only on two factors: (1) creativity and knowledge of talented employees and, (2) the effectiveness of the methods and processes that support their work. In this paper a synergy that aims to help in both dimensions – creativity and knowledge- is presented. The first element in the synergy is the Case-Based Reasoning process, useful to store and share knowledge. With regard to creativity, an approach capable to support ideas generation for systematically solving problems is needed. Recently, a new approach that conceives innovation as the result of systematic patterns in the evolution of systems has emerged in the industrial world: the TRIZ theory, which is the second element in the synergy. Next section briefly presents this synergy.

II. The Theory of Inventive Problem Solving

This theory was proposed by the Russian scientist G. Altshuller in the 1940s; actually it's a well accepted approach for solving problems. TRIZ has several advantages over traditional methods, particularly when it's applied in the early design stages. The main advantages are:

- TRIZ offers an important collection of knowledge extracted from several domains. This capacity produces an environment where knowledge could be used in a transversal way. As a consequence, the application of TRIZ is not restricted to a single technical domain.
- TRIZ is a more equilibrated approach that combines, in the same environment, a psychological and technical creativity's points of view. This capacity lies in its structure. TRIZ combine in its structure four essential areas: (1) a statistical patent analysis (more than three millions) to derive some general solving strategies, (2) a synthesis of the main advantages extracted from numerous techniques for problem solving, (3) an analysis of the inventor's creative thinking patterns, with the aim to produce a set of strategies to model and to solve problems, and finally, (4) a capitalization knowledge process in scientific literature. The analysis of those areas, leaded to create some tools that make a tangible link between knowledge and action (Cavallucci, 1999).
- This process guide to TRIZ cornerstones: (1) all engineering systems evolve according to well defined regularities. (2) The concept of inventive problem and contradiction, like an effective way to solve problems. This also means that any problem could be stated like a contradiction, and, (3) the innovative process can be systematically structured (Terninko et al. 1998).

Like any other approach, TRIZ has several limits. Some of the most important in the present context are: (1) TRIZ doesn't have a memory. Consequently, TRIZ can not remember specific past solutions while solving problems. This procedural knowledge it's then no available for other persons facing similar problems. (2) TRIZ uses general knowledge and, according Kolodner (Kolodner 1993); the application of this kind of knowledge in a particular situation could be

extremely difficult. Those limits need a tool or methodology capable to store and reuse knowledge; central capacities of the Case-Based Reasoning process. Next paragraph offers a succinct description of this AI tool.

III. The Case-Based Reasoning process (CBR)

In the CBR process, problems are solved by reusing earlier experiences. In this process, a target problem is compared with cases or specific problems encountered in the past, to establish if one of the earlier experiences can provide a solution. If a similar case or set of cases exists, their associated solutions must be evaluated and adapted to find a new one. This approach has proved its utility to support design activities, equipment selection and also knowledge management activities among others (Avramenko et al. 2004).

The CBR as methodology for problem solving encompasses four essential activities: retrieve, reuse, revise and retain. In this process, the problem solving process starts with an input problem description or target problem. This description is used to –Retrieve- a problem or set of previous solved problems (cases), stored and indexed in the memory. Then if one or various stored cases match with the target problem, the most similar case is selected to –Reuse- its solution. Subsequently, the derived solution must be -Revised-, tested and repaired if necessary in order to obtain a satisfactory result. Finally the new experiences which comprise failure or success, but also the strategies to repair and implement the final solutions (among others particular features), are -Retained- for further utilization and the previous cases memory is updated.

The CBR process has limitations such as: (1) the case-memory store case for a single domain case. This is in fact, one of the most important advantages of this process, but applying this specific knowledge-base to innovation projects, could be an obstacle to creativity. (2) Another consequence of the limit mentioned above, is that creative solutions available in others domains can not be considerer while solving problems. Nevertheless, the quantity of sources and domains utilized when solving problems has a positive impact in the obtained solution.

As a result, TRIZ needs an element capable to store and reuse knowledge, and the CBR process needs an structure that facilitates the access to solutions obtained in other domains and also a general knowledge structure to index cases in the case-memory. Next section briefly describes the combined approach TRIZ-CBR.

IV. The TRIZ-CBR synergy

The CBR process needs an abstract generalization that will be utilized to store and to index the problems in the memory, consequently an extremely flexible structure is desirable. While analyzing the world patents data bases, Altshuller and his research team realized that even the most creative inventions have common principles. They also found that an inventive problem could be formalized with a reduced number of parameters. This observation guided to formalize 39 Generic Parameters and 40 Inventive Principles (Altshuller, 1999). Both elements were organized in a 39*39 matrix named Contradiction Matrix -48*48 in the new version- (see figure).

	1	2	3	4	5	6
1	+	–	15, 8, 29, 34	–	29, 17, 38, 34	–
2	–	+	–	10, 1, 29, 35	–	35, 30, 13, 2
3	8, 15, 29, 34	–	+	–	15, 17, 4	–
4	–	35, 28, 40, 29	–	+	–	17, 7, 10, 40
5	2, 17, 29, 4	–	14, 15 18, 4	–	+	–

Figure 1. Fragment of the Contradiction Matrix

An inventive problem is one that contains at least one contradiction and an inventive solution, that which surmount total or partially one contradiction. The condition where any attempt to improve one useful system parameter or characteristic, has an unacceptable impact in another useful feature is called a technical contradiction. This kind of problems is usually solved with trade-off solutions. Altshuller found that several methods to satisfy contradictions were available and easily exploitable. So, those strategies were arranged to accomplish this objective inside the contradictions matrix, which play the role of memory in the TRIZ-CBR synergy.

This matrix contains the statistical analysis of over 3 millions patents. This work next phenomenon: “if two problems share the same contradiction, then their nature it’s similar and

consequently, the associated solution of the first one, could be applied on the second" (Altshuller 1999, Mann 2003). The application of this TRIZ tool, it's really simple: In the first column identify the parameter that needs to be improved and in the first line, the parameter that get damage. The intersection between line and column isolates the successful inventive principles used to remove or minimize similar contradictions across domains. This concepts it's then capital to construct a contradictions case-memory. Consequently, this synergy aims to solve inventive problems.

Another key TRIZ concept is utilized in the synergy: Ideality. A TRIZ tool based on this concept is the Ideal Final Result (IFR). This tool helps solvers to explore the solution space and concepts generation. The IFR is a solution that: (1) eliminates the deficiencies of the original system. (2) Preserves the advantages of the original system. (3) Does not make the system more complicated (uses free or available resources) and (4) does not introduce new disadvantages. Those TRIZ concepts defined, it's possible to present the process at the core of the synergy (figure 2):

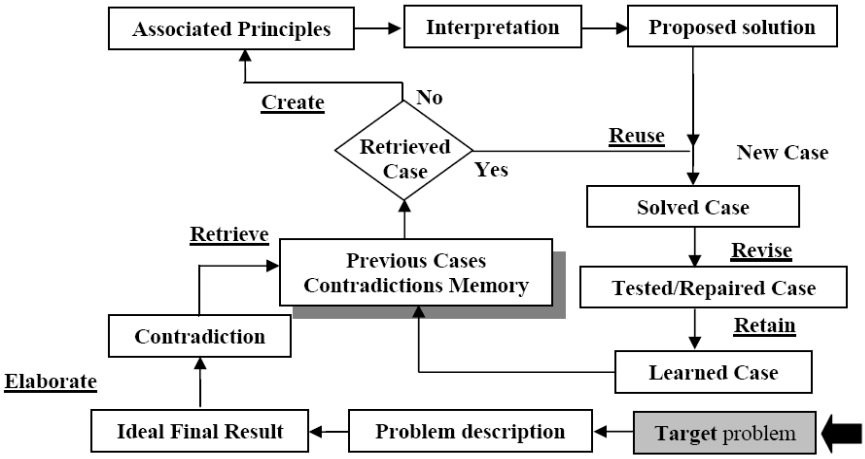


Figure 2. The TRIZ-CBR synergy

In the process schematized in figure 1, the target problem is described and modeled as a contradiction. Then, this contradiction and some other elements derived from the problem description (available resources, objective, sub-systems, among others) are used to retrieve a similar case in the memory. This search could offer or not a similar case. This condition generates two different sub-processes:

1) A similar case is retrieved. So, its associated solution is evaluated to decide if such initial solution will be reuse.

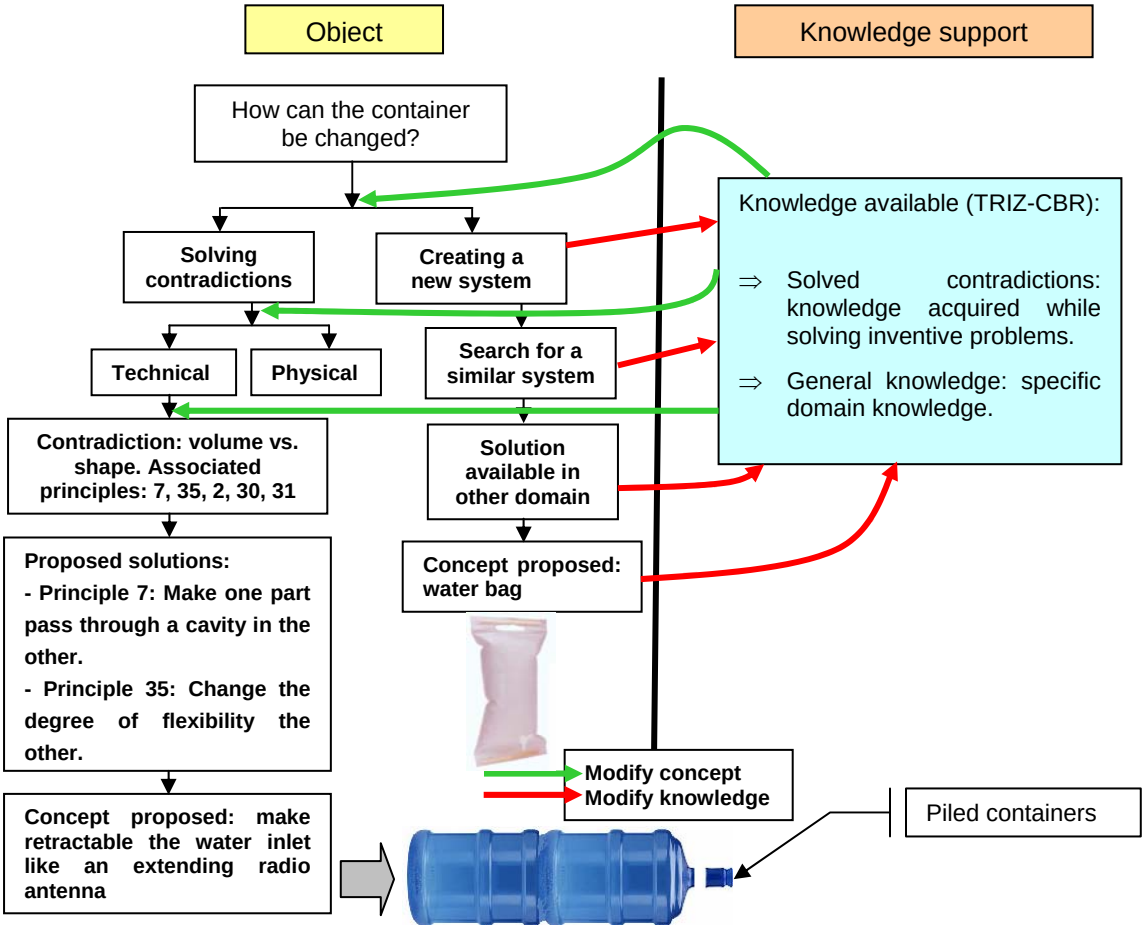
2) No similar cases are stored in the memory. Thus, the system will propose at least 1 inventive principle (and no more than 6 between the 40 that exists), that has been successfully used in the past, to solve this specific contradiction in some other domains. Afterward, the inventive principles which are in reality some standard solutions or strategies to solve problems, must be interpreted to propose a potential solution.

Subsequently, both sub-processes converge and the proposed solution is then verified and repaired if necessary in order to obtain a satisfactory result. Finally the new experiences which comprise failure or success, strategies to repair and implement the final solutions, among others particular features, are retained for being reusable in the future and the case memory is updated (Cortes 2006).

V. Examples

The fist example shows how a problem was stated and solved. The problem is to maximize the available space in vehicles when transporting purified water in a 19 lts container (see next

figure).This problem generates numerous inconvenient: (1) containers can not be placed vertically (one upon the other). This reduces the batch size in a vehicle and also the delivery rate. (2) If they are placed vertically one next to the other, it is difficult to operators to pick-up the container; this also represents a risk of injury. (3) Its necessary to adapt a structure to load and transport the containers. As a result enterprises spend money adapting its vehicles. (4) Clients had expressed that it's difficult to move containers. Besides, enterprises and clients have pointed out that the most frequent accident occurs when they are moving or transporting the container. As a result, a new container is needed, one that maximizes space, reduces difficulty associated to transport and minimizes the risk of injury. In addition, an excellent transparency level it's a priority. Next schema shows how this problem was faced.



This schema shows two different solutions: fist one suggests transforming the container in such a way that one could be placed one upon the other by retracting and extracting the container water inlet. This solution can solve partially the transport problem. Second one proposes to completely change the actual system. IFR suggests recommends to describe the ideal system, which in this case, it's a container that: does not have any physical dimension (weight, volume, etc.) but which accomplish its useful function. The most similar system it's a water bag developed in the aerospace industry. This option is actually under analysis to propose a new way to distribute water. Clients have manifested an initial and natural opposition to this project, but nowadays, they see the project from a different perspective. This project also involves other industries such as: recycling industries, services, communication, among others.

VI. Conclusion

The process schematized in figure 2 encloses a process where knowledge it's applied in a very dynamic way. The problem faced modifies the available knowledge and knowledge impact the design process. But the synergy has another capital advantage: the TRIZ-CBR synergy has the capacity to offer solutions even if a problem had never been faced in the past, and also to

remember how a solution was obtained. The contradictions based memory, allows prevention where a solution had failed or to increase success possibilities when a successful solution was created. This capacity reduces effort in problem solving activities, accelerating the innovation process.

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Organizational routines and dynamics of organizational cognition

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Abstract: R&D and innovations processes are activities rooted in social structures, cultural norms and values in individual and collective perspectives related to each other. Thus, technological knowledge is linked at the individual and collective actions and decision. However given the nature of linking between actors related with R&D and innovation activities, decisions and actions, oriented to generate new technological products and processes, transcend individual interpretations and assumptions about technology and its environment. In this sense, R&D and innovations processes come from the interactions among these interpretative systems of each particular actor involved in those activities within firms. Organizational behaviour literature has called this interaction "shared cognitive structure."

From our point of view, shared cognitive structures could eventually become manifest in the form of new products. We propose that both a focus of cognitive topics and an approach of predictable behavioural (or not behavioural) patterns like rules and routines, can allow identifying explanations about shared cognitive structures for managing R&D and innovation activities.

This paper examines concepts from resource-based, technological frames and knowledge-based views to suggest a framework for analyzing shared cognitive structures from routines and rules point of view, oriented to search new ways for managing R&D and innovations activities.

Keywords: organizational routines, dynamic capabilities, social cognition

I. Introduction

The social cognition part of the assumption that the people act on the base of their interpretations of the world and that doing this they represent an individual social reality and give to it meaning (Orlikowski y Gash, 1994). Weick (1995) shows that through of these interpretations, actor 'make sense' of the context and the activities that they evolve before they can act. March and Simon (1958) assume that within an organization, everyone has a cognitive base that serves to organize and to form their interpretations of the reality and give them meaning in order to be able to act: assumptions about the future, knowledge about different alternatives and foresee the produced by these alternatives. In this way, each organizational member has a reference frame. These individual frames have been coined by cognitive psychology as "schemes"; however, literature in organizational behaviour has extended this individual idea to groups and organizations that has called "shared cognitive structure".

Literature of social dynamics cognition (Howells, 1995; Swan & Newell, 1998; Nicolini, 1999, Kaplan and Tripsas, 2004) has tried to explain these aspects revealing the beliefs that are shared by the members of an organization and how organizational decision can be probably different to individual beliefs.

II. Technology frames

For firms to achieve a purpose, people do not have to agree on personal goals, and in the division of labour in an organization they will have different knowledge (Cusmano, 2000). However, it is necessary to share certain basic values and perceptions about environment to align their competencies and objective orientation. When the people are confronted with

environment, they use their cognitive base to "form simplified representations of the information environment" (Kaplan and Tripsas, 2004) which reduce the complexity of environment, to be able to make interpretations of the environment and afterward, decide and act.

Processes oriented to R&D and innovation activities are related with capabilities to create new technological knowledge and transfer it across of the organisation. However, this transfer process could be carried out by the firm as a result of organizational recurring processes characterized in organizational routines. In this way, both interpretative frames and organizational routines could be important because they capture how actors (users, producer and managers think about technology (Kaplan and Tripsas, 2004), and on the other hand organizational routines define specific process to identify shared cognitive structures.

The concept 'Technological frames" (coined by Orlikowski and Gasth (1994)), can be defined as the process through which a producer or user approaches a set of interpretative processes for taking a certain action. In this sense, individuals focus on the particular interpretations made about technology and its role within the organization.

However some researchers have expanded these ideas emphasizing the social characteristic of technological frames, their implications for technology trajectory and their implementation and use (Orlikoswki and Gash, 1994). This collective technological frame has been defined as the outcome of interactions between users and producers and between them. The interpretations of different actors interact between each other and with the technology to produce outcomes. This process involves sharing of personal experience and individual technological frames. This process could create a common frame facilitating collective learning (Spender, 1998), and defining rules and routines that constitute what the company makes in terms of its actions and decisions around innovation activities

As it were said before, the technological frames are the lenses through which the company collects and interprets the reality. But an "interpretative process" it is necessary to connect the technological frames to technological outcomes. Trips and Kaplan (2004) defines four states for this process: attention, interpretation, decision and action. In this process, an actor (users, producers, managers) collect and filter of the atmosphere, soon gives a meaning him to this information, soon what he was interpreted is transferred to actions or results. These authors affirm that this process is iterative; that the technological frames could be modified, and in the same way, the collective technological frames are the interactions between several interpretive processes of diverse actors within or outside to the firm.

III. Organizational routines

An organizational routine is considered as a regular and predictable behavioural pattern of firms that is part of the recursive process that constitutes an organisation and have autonomy through their repeated application and in response to selective pressures (Reynaud, 1996; Cohen, 1995). Each routine relates to a given task within a specific activity, and provides the action according to the instruction defined by rules or depending of shared cognitive structures. In this context, organizational routines are not a single pattern but a set of possible patterns enabled and contained by a variety of individual cognitive structures (Pentland and Rueter, 1994). In this sense, technological frames define how companies operate and how they define their rules and routines.

This notion of routine has confluence with shared cognitive structures in terms of selection, aptitude and learning, and the role of context. However, the emphasis in this definition is on selection process which implies the possibility of the automatic character of the routine and the outcome of a selection process are defined for specific collective cognitive frames. In this sense, shared cognitive structures are an important action for create rules and routines.

IV. R&D Activities and technological frames

R&D and innovation activities, it can be something diffuse during periods of knowledge creation, but these process are structured when new products or new processes are defined, or in periods of incremental innovations. In these periods of time the actors (user, producer, managers, institutions , etc.) choose, invest, support or adopt a technology. The actions defined by each one of them have an effect on the way to follow by a given technology, and the individual experience of actors create a shared understanding of technology because individual frames act of other technological frame and finally the collective technological frame is the result of interactions of actors. The set of actions taken by several actors will form the evolution of the technology. In the process of decision making on what technologies to follow, the companies incorporate their interpretations of the technology, the necessities of the users and their own capabilities.

According to Orlikowsky y Gash (1994), collective technological frames define categories and performance criteria that help actors understanding functions that technology might perform. In the same way, collective technological frame is related with organizational history, their prior experiences, and with the accumulated knowledge of actor's interaction. In this sense, organizational routines and rules can be used to support mechanism of dependence or interdependence between individual and organizational thinking.

In terms of R&D management, relationships between actors are different depending of what outcomes looks for. Thus, cognitive frames of producers can be analyzed in different form than relationships between producer with users or managers. Thus, individual habits and collective routines can define what actors are looking for.

Effectiveness of R&D activities, in terms of manage this processes, could be oriented to identify whether knowledge production depends of the capabilities of integration and absorption of these frames. However this integration process could be useful or could be not. It depends on the features of the technological field being investigated when we are talking about R&D activities of creation of new knowledge. Some technological areas require partners with cognitive proximity and reciprocal knowledge absorption, some other technological fields require the integration of diversified competencies not necessary related to the same technological fields. For instance for reciprocal learning takes place, producers (or partners) should have sufficient cognitive distance[1], since they possess different technological frames, in order to create "non-redundant" knowledge (Cusmano, 2000), but on the other hand they should be close, in technological frames to enable fluently communication. Cusmano (2000), quoting to Metcalfe (1995), shows how the main concern of R&D activities is ensuring equilibrium between "creative destruction" and "order", which meaning as "coordination of the system rather than convergence to a centre of gravity".

In this sense, the R&D management could be oriented to identify collective routines that enhance their specialized knowledge, but additionally it is important to identify individual habits that could be better used without share collective frames. Collective routines and individual habits can be identified more easily than technological frames.

V. Conclusion

Technological frames attempts to reproduce routines within an organisation. This notion of routine has confluence with shared cognitive structures in terms of selection, aptitude and learning, and the role of context. These routines can become habituated in norms, refined in

[1] In this context, cognitive distance is referred to different life paths and in different environments, where people interpret, understand and evaluate the world differently (Cusmano, 2000; Noteboom, et al 2006)

other routines and/or changed to new behavioural actions and oriented to specific technological decisions. In this sense, is easier to identify routines than technological frames.

This article shows an approach of the associated factors for R&D and innovation activities for capturing and representing the organizational cognition oriented to R&D and innovation activities.

R&D management could be oriented to identify collective routines that enhance their specialized knowledge, but additionally it is important to identify individual habits that could be better used without share collective frames.

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Use for a creative and innovative approach in product design. Case of students-enterprises linked projects

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Abstract: The training program of Iteem, a French graduate engineering school, includes a design and achievement project of product/service for an enterprise; this project is realized by a team of 5 students. We present the contribution of an original creative and innovative approach in the first steps of such projects; this method uses a tool named "Creassiste". Innovation has a big role in the Iteem program, because our objective is to train future entrepreneurs in the field of high technology. Each project is followed by a lecturer during the whole process; one of his/her mission is to bring methodological supports in order to innovate. The interest is as follows: the students have a practical experience of innovative solutions research on a real problematic, and the enterprise discovers new possibilities to develop innovative solutions. By experience, all types of enterprises are interested, but our target is rather the SME (small and medium enterprise) that cannot take on engineers, due to their wage costs. But this approach has also been initially used in design projects for large enterprises.

Keywords: Creativity, Innovation, Product design, Education

I. Introduction

Iteem (European Institute of Technology, Entrepreneurship and Management) is a joint venture between two French high schools: Ecole Centrale de Lille (engineering school) and Ecole Supérieure de Commerce de Lille (school of management). The aim is to train future entrepreneurs in the field of high technology. Job opportunities are in the field of business start-ups, SME development, but also large enterprise that needs this qualification as "intrapreneurs" (persons able to innovate and develop a sector of an enterprise).

Recruitment is based on academic excellence and personality. The entrepreneurial skills are developed over the five-year study period, mainly by means of project-based activities mixing business and industrial sources. A successful student receives a master's level degree in Engineering and Management Sciences accredited by the National Degree Board.

The course schedule is given figure 1. Three projects are planned during the first three years period; we focus on the 2nd year project. Each student devotes 120h of work for his/her project.

Figure 1. Schedule of the Iteem training program

The work has to generate added value for an enterprise by creating or improve a product/service. It is supervised by a lecturer helped by a teaching team. At the beginning, the enterprise proposes a subject that is very often formalized as a solution; sometimes, the subject isn't identified and the student team has to work out the problem they will have to deal with. Several tools are proposed in order to efficiently define the problem.

The purpose is, in the early phase of design, to come back to the real problem and to search and select innovative solutions that respond to this problem.

II. Training course in method for innovative concept generation

About three months after the beginning of their project, the students have a 15 hours training course in method for innovative concept generation. At this time, they have a good knowledge of the enterprise (activities, organization, culture…) and a good appropriation of the problematic they have to deal with.

This method has previously been used in two types of applications: problem solving (in quality management systems) and innovative design (in product development projects) (Bigand and Yim 2005, Ngassa et al. 2003). In this second case, it proposes to add two phases before a traditional design and achievement project (Christophers 1997): first the needs definition phase and second the innovation and selection phase (see figure 2). The three phases need knowledge acquisition (Hadj-hamou and Caillaud 2001, Mascitelli 2000).

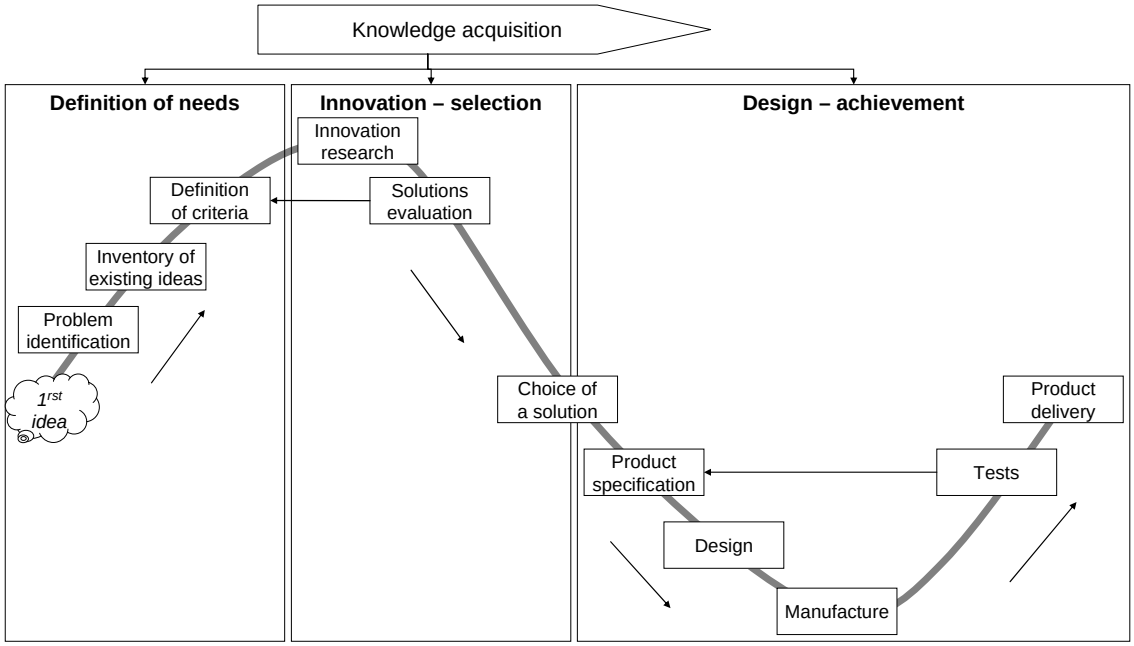

Figure 2. Overview of the method for innovative concept design

There are 3 steps in the definition of needs: (i) the identification of the problem whose objective is to clarify the true problem (indeed the first formulation is often not apprehended at the right level), (ii) the inventory of existing ideas (listing of the previously explored solutions and eventually the cause of their rejection, in order to avoid an actor focuses on "his/her" solution), and (iii) the definition of criteria (the team has to define concrete, positive and measurable criteria and constraints a solution must satisfy to be relevant).

In the innovation – selection phase, the idea of the first step is to generate a maximum of ideas; we have chosen to use creativity methods (Buzan 2003, Bohm 1998, Vissers 2001) (animal crackers of Grossmann to improve the abstraction capabilities and Triz (Altshuller 1988) to improve the knowledge level). Each solution is then evaluated in regard of the previously

defined criteria. Then a solution is chosen, which can be the combination of different solutions in order to optimize the criteria and satisfy all the constraints.

The class consists in using this method by groups of two/three students on their own projects; moreover, the groups are constituted with students from different projects. So, we benefit from the contribution of neophytes about the subject. Finally, the students present their results in an oral restitution in front of a group of 16 students plus their lecturer.

A software tool named “Creassiste” has been developed in order to facilitate the procedure for the method, to allow using Triz and animal crackers modules, and to make the document production easier.

With this training program, we consider that the student acquires a first practical experience in innovation methods. It is then completed by fundamental courses (Yannou and Bigand 2004, Bigand et al., 2000) for the student who chooses an improvement in “Design of industrial product”.

III. Example of application in a small enterprise

The activity of the SME (about 20 persons) is the recycling of old personal computers. This enterprise recruits essentially worker that are minor mentally handicapped persons. Clients that want to dispose of old PC pay this enterprise; the PC are dismantled and some materials are sold, the rest is sent to a waste reception centre.

The first formulation of the project wasn’t clear; the enterprise had to relocate from the actual cramped local to a new spacious place. After several interviews and investigations, and by using a check-list of questions, the subject was more defined: the student’s team had to design and install a prototype of ergonomic workstation.

Then, they went on several occasions in the firm and dismantled themselves several types of products that represent 80% of the activity. So, they had the possibility to know better the process, the actors (that is important for future workstation acceptance), and to collect several important information. They can then model the process in order to highlight the value flows, the activities with a weak added value…

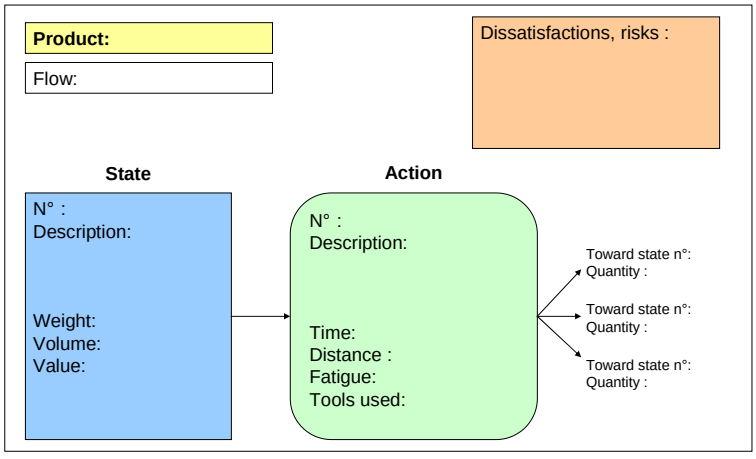

Figure 3. Form for the manual typing of the information about an action of a dismantling process

After this work, they have a good understanding of the actual situation and used “Creassiste” software in order to discover potential innovations.

In the definition of needs phase, they identified by successive zooms the basis problem: safety regulations aren’t respected and the responsibility of the direction is directly engaged. For

example, instead of to use a screwdriver, workers sometimes hit with a hammer on the PC or throw the PC to the ground… Taking into account the safety of the workers, among the criteria, for example, the reduction of the noise was defined (<60dB).

During the innovation – selection phase, the use of animal crackers (territory: to create the involvement by a value sharing, animal: Australian male bird that built a beautiful branch structure in order to attract its female and decorate its nest with coloured materials) allowed finding several ideas: to include in the workstation a detachable space of personalization, to use colour codes in order to materialize material flows… The use of Triz contradiction matrix (adaptability or polyvalence / system complexity) leads to the use of pneumatic tools, of a rolling stool in semi-sitting down position, and a modular workspace (for potential additional facilities to be adaptable for new products as microwave oven recycling, for example).

The rest of the project is more classical and isn't developed here.

IV. Conclusion

We have presented how a structured method can be applied in the context of a training program with an active teaching method; the lecturer has to be familiar with the method and available at the good time. This program includes other parts in order to develop student's abilities. The enterprises have a lot of benefits in working with students by project: about 600h of high level work is devoted to the project, and an operational realization is built. This is interesting for SME and large companies.

Actually we train about 12 projects per year; our objective is to generalize this approach in a more large scale (60 projects / year).

We also work currently on the "industrialization" of the process of participative innovation for the design of product in a large company; this process can use the method and the corresponding "Creassiste" tool.

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High performance collaborative networks: a realistic innovation or just an academic desire?

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Abstract: This paper presents the preliminary findings of a research project aiming at the definition of the conditions required for the creation and management of high-performance collaborative business networks in Northern Portugal. Given the industrial context of the region the emergence of such networks would be innovative in itself. The project adopted a multiple-case study research strategy, based on data from 40 semi-structured interviews. The preliminary results of the study include: 1) operational definitions based on an extensive literature review; 2) a conceptual framework for the analysis of high-performance collaborative networks; and 3) recommendations for the creation and on-going management of such networks.

Keywords: business networks, collaborative technologies, network performance evaluation

I. Is there such a thing as a Collaborative Network?

The term "network" is widely employed and researched across scientific disciplines and professional fields. In social sciences several schools of thought can be identified whose research focus is the network. Araujo and Easton (1996:65), for instance, compare 10 such schools of thought, whereas Oliver and Ebers (1998:556) compare 17 of such schools. In addition to schools of thought, these articles identify key elements of networking allowing a systematic comparison of those networks and schools. The present paper is based on the results of the RCED project (High-Performance Collaborative Networks), whose ultimate goal is to support the creation and on-going management of collaborative business networks, by proposing innovative ways of fostering networking and collaboration. Most of the project analysis was performed in Northern Portugal.

Although forged recently, the term "Collaborative Network" can have several interpretations according to the context in which is being used. It is often used to refer to any kind of network where some form of interaction exists, from virtual professional communities to supply chains. This broad interpretation is useless if we want to study the implementation of networks of SMEs and to contribute for some kind of innovation in this area. A more precise definition can therefore be much more useful: a "collaborative network" is a set of independent organisations which cooperate through ICT-based collaborative processes (collaborative technologies). This definition is, in turn, closely related to two other definitions: "cooperation" is "the articulation of strategies and activities of two or more organisations in order to achieve commonly set objectives"; "collaboration" is "the process by which two or more organisations perform tasks together in order to obtain collective results". Understandably, this definition of "collaborative network" is based on insights from several schools of thought. In terms of "cooperation" the key insights are: *need for mutual trust, division of labour*, and *adoption of common practices*. Concerning "collaboration" the key insights are: *shared tasks* and *impossibility of achieving collective results individually*.

It should be noted that when trying to build up a precise definition of collaborative network, we could only find a few cases where collaboration is the cornerstone (Wong, 2005; Forfá s, 2006).

Although being an area of research for many years, collaboration between organisations is still an innovation topic, with ongoing research work, both in informatics and in organisation science.

II. How to understand Collaboration and Networks?

The RCED research project was designed to ensure a coherent relation between: a) the theoretical and practical contributions of the study, b) the adopted research method, and c) the sources under analysis. In particular, RCED's contributions can be framed in terms of the following research questions: 1) What are the best academic and empirical theories of high-performance collaborative networks? 2) What elements of networking best describe collaborative networks? 3) What is the current status of collaboration in Northern Portugal? and 4) How should collaborative networks be created and managed?

Based both on theoretical and empirical roots, the RCED project has defined a conceptual framework that includes five conceptual modules:

1) an analytical grid of business networks, considering six elements of networking (see below) to allow the description and the analysis of colaboration networks;; 2) a business network typology, defining nine types of networks; 3) a list of favourable conditions for higher levels of performance in collaborative networks; 4) a methodology for performance evaluation of collaborative networks; and 5) a typology of collaborative technologies (based on the dimensions and level of collaboration).

RCED thus proposes an "analytical grid" that specifies and analyses collaborative networks in six dimensions. These dimensions are the "context" (information about the network's outer-environment), the "actors" (type of network nodes), the "motivation" (network's strategic aim), the "activities" (value-added activities performed by the network), the "resources" (content of connections between network nodes) and the "relationships" (type of connections between network nodes). In addition, RCED proposes a "network typology" that considers nine types of networks: *distribution network, production network, extended enterprise, virtual enterprise, research network, supply hub, innovation network, cluster,* and *virtual breeding environment*. The "favourable conditions" are the most relevant pre-conditions for higher levels of performance in collaborative networks, for each type of network. Such conditions are grouped according to five types of resources: *human, financial, social, infrastructural* and *organisational.*

A "methodology for performance evaluation" of collaborative networks was developed in the RCED project since no such type of integrated methodology was found in literature. Such a methodology recognises that performance evaluation of a particular enterprise network is strongly dependent on its objectives and type. From the perspective of individual participants, performance can be assessed with a comprehensive set of evaluation criteria and indicators. From a global perspective, network performance can be assessed using a multi-criteria approach. The fifth and final module of RCEDs' conceptual framework is a "typology of collaborative technologies" that classifies the available support technologies in a matrix with the "dimensions and level of collaboration". Collaboration dimensions include communication, information sharing, and coordination. The collaboration level can be defined as basic, medium, and high.

III. And when Collaborative Networks are not in line with SME's strategies...?

The cases analysed suggest a low level of "high-performance collaborative networks" adoption among businesses. In theory each company possesses specialised knowledge, experiences, and talents that, combined with other companies, form a whole that is far more valuable than the sum of their individual parts. However, in practice huge limiting constraints could be found and very few businesses were embracing collaborative networks that are able to reap these benefits. Collaboration can be time-consuming, challenging and difficult to implement, yet the rewards often outweigh the costs. The following two cases taken from the RCED field research illustrate these difficulties.

The first case is a failed implementation of a supply hub. This supply hub was sponsored by a sectorial association of SMEs and was viewed as an opportunity to be competitive against large

groups, by lowering the procurement costs. The motivation of participant companies was mainly related to the possibility of having access to special materials and components, and of lowering purchasing prices. The necessary IT platform was set in place to support both the supply hub and also an e-marketplace. Most of the people participating through their companies had only co-membership relations in the scope of the association. In other words, they were competing companies that recognised the need to cooperate, in order to be more effective towards their clients. The management of the association was fully committed and professional managers were hired for the project. In addition, every member had to pay a fee to be part of the hub, thus further signing commitment to the network. What went wrong then? Apparently, cultural and social factors, namely the lack of enduring trust between companies as well as questionable ethical conduct from some companies (there was no control of the entrance of new companies). These two factors were, in turn, reflected in increased difficulties for some network activities such as knowledge sharing, joint training, etc. It seems that a wrong partner selection was the main reason for this failure, probably related to the fact that the negotiation power with suppliers was quite unbalanced among the different network members.

The second case is an electronic commerce distribution network, created to join producers of regional quality food products in the North-Eastern part of Portugal. It was initiated by the technology transfer unit of a polytechnic institute that has created the business model and set up the IT infrastructure. The fundamental activities of the network were commercialisation, marketing and distribution. The basic network rules were that each producer should maintain minimum levels of stock and quality of the supplied products. This was object of a contract. The network leader was the technology transfer unit. This network failed apparently due to lack of commitment and strategic consensus. The leader and some of the members were not able to develop sustainable marketing activities (due to financial difficulties), while other members did not comply with the contracts. Others demanded exclusivity on some products. In other words, an effective collaboration aiming at joint strategy was never achieved.

IV. What to do then?

The strategy followed by RCED to foster collaborative business networks is anchored on the concept of Collaboration Breeding Environments (CBE). The creation of a highly trustful business environment may be supported by cooperation agreements, transversal business processes and technology infrastructures. Such a breeding environment enables businesses to reap the emergent market opportunities related to the “networking effects” (value chain cooperation, shorter lead times and quick response). The main drivers of CBE are Collaboration Research Practice; Collaboration Training; Collaboration Knowledge and Collaboration Labs.

- Collaboration Research Practice – To develop studies of socio-economic and technology issues in combination with academia researchers and practitioners. This practice could improve the quality of research and help create theory grounded in social experience. It requires mutual respect, trust and appreciation among the individuals involved, and a willingness to learn from each other through formal and informal means.

- Collaboration Training – To place real world experience into knowledge; It means to transfer real time collaboration experiences to businesses, ensuring that knowledge is captured and avoiding pitfalls; employing collaboration training technologies (web conference, b-learning and simulation engines).

- Collaboration Knowledge – To create an on-going collaboration database; to form Communities and Special Interest Groups around the collaboration issues. Employ software to develop a web-based workspace that combines the best of collaboration, knowledge management and document management technologies into a single solution for enterprise collaboration.

- Collaboration Labs – To enable trials and take-up of cutting edge applications carried-out by global ICT suppliers; Intellectual property protection is needed. A virtual science laboratory could also be also included.

RCED will carry out a set of dissemination activities for promoting CBE. These activities include

Collaboration Workshops and the Collaboration Kit and should be implemented by a team with specific competences in collaboration issues, management and technology, dissemination and transfer of knowledge;

- Collaboration Workshops will be used to promote the exploitation of results, to kick off technology initiatives or to solve stand-alone business problems. They aim at building consensus among parties by bringing together all the key members within an organisation and facilitating them through a series of collaboration tasks.
- The Collaboration Kit will include freeware software applications (focused on collaboration); collaboration self assessment tools; knowledge management; performance criteria; best practises; action plans for executing technology initiatives.

V. Conclusion

A political perspective on organisations tends to emphasise the lack of consensus in such entities whether they are private, public or not-for-profit. In the case of collaborative networks, this lack of consensus is further aggravated by the scope and scale of interests involved. One can thus refer to the political challenge of networking which is well illustrated by the two cases in section III.

As a multifaceted phenomenon, networking additionally poses economic and technological challenges. In particular economic issues are directly reflected in network participants' motivation, which is often business related. This involves the dilemma between costs and benefits of networking. More often than not, such costs and benefits are unquantifiable and unpredictable. This, in turn, raises the issue of performance evaluation as a crucial aspect of networking for both the participants and the whole network.

In practice, however, the political and economic challenges of networking are rarely dissociated from technical issues. In other words, the practical implementation of collaboration in general and of collaborative networks in particular results from technical arrangements that further reinforce political and economic consensus among participants. The project findings also reinforce the idea that the adoption of collaborative technologies is viewed by companies as a means to enhance their own competitiveness.

Finally it should be noted that the RCED project has clearly acknowledged the multidisciplinary nature of networking by analysing both organisational and technological issues. Its conceptual framework tries to clarify the business rationale of cooperation as well as the notion of collaborative technologies. In particular, the concept of collaborative breeding environment aims at supporting the concrete application of such framework.

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A second look at the complex innovation phenomenon through a "dialogical" principle

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Abstract: Today, organizations are entering into an area of accelerated movement. Their functioning modalities have to include a more important part of capacity to be flexible and to face the changes within the more and more uncertain business environment Kreiner (Kreiner cited by Olsson N.O.E., 2005).

In order to survive in this uncertain environment, companies have to make a strategic choice. Either by focusing on their core activities or by diversifying their offerings, etc. while giving a significant part to innovation in terms of products, processes or technologies.

This article, built from qualitative individual manager interviews, attempts to introduce a theoretical approach of innovation based on the complexity paradigm. We are convinced that a better understanding of the innovation's complexity will help managers to respond with innovation and intelligence to this phenomenon.

Thus, understanding innovation's complexity and different possible resulting reactions are essential factors in guaranteeing the perpetuity of the organization.

Keywords: Innovation, complexity, "dialogy", manager, skills, learning

I. Introduction

Scientific progress acceleration, globalization and the advent of the information society contributed to the increasing complexity of our societies. The ability of companies "to benefit" from this complexity will be a determining aspect of the future innovation capacity.

Development concerns in this more and more open and complex world are crucial. They are linked to their embedding capacity into innovation and their functioning modalities in-depth change. All of this happens in a more or less open way, with the application of the management project mode within the organizations, as it is a necessary key (it is well known that it is not a sufficient condition) in facing changes, even in controlling them and favouring innovation in order to ensure perpetuity.

On the other hand, collaborators' skills are obviously crucial in these organization modalities, whether these collaborators are project managers, or they are, in one way or another, in charge of the organization transformation, which seems obvious, or even they are operational collaborators who have to work in these changing environments.

Within the framework of this research, we used the complexity paradigm to better understand the innovation dynamics and this by proposing a second look at this phenomenon by the the complex thinking epistemology.

Innovation is a complex phenomenon because it generates a change in the usual chain of processes and organizations functioning. It often results of unusual combination of known aspects, made without taking into consideration the disciplinary boundaries that sometimes separate them.

II. Research background

1. Complexity paradigm

One definition of the complexity as proposed by Edgar Morin (Morin, 1977) was by distinguishing the complexity from the complication "Complexity is not complication: what is

complicated can be reduced to a simple principle […]. Thus, the real problem is not to reduce the complication of the developments to simple basic rules. The complexity is at the base…".

Indeed, it is important to avoid trying to eliminate the intrinsic complexity of the innovation activities, by simplifications, which could distort the phenomenon, but rather to accept it as a fundamental and inseparable characteristic of the question and to develop a reflection aiming to better understanding this phenomenon of innovation in its complexity.

As pointed out by Mélèse (Mélèse, 1979) "Complexity is not the bad absolute chased by the beautiful French rationality in the name of clarity, of homogeneity and of universalism. On the contrary, it is the acknowledgement of wealth and variety". This passage allows us to reconsider the problem of complexity under a new angle of approach where rather than trying to reduce, at all costs, this complexity, we prefer to consider it, and according to Franchistéguy (Franchistéguy, 2001), as a complete cognitive "constraint" which translates, in a sense, its wealth.

Otherwise, it seems necessary to go beyond the usual frameworks by using "cognitive filters"[1], that seem contradictory at the first sight, but which are necessary for understanding.

2. "Dialogical" principle

In coherence with a constructivist epistemology, comprehension, which we usually attach to innovation, is strongly linked to our representations and perceptions of the "reality" which in our case corresponds to certain grounds of investigation and certain convictions, values and cognitive habits. As Le Moigne said, "The existing and knowable reality can be built by its observers who are from then its manufacturers" (Le Moigne, 1994) and thus "Science reaches only the representations of the reality" according to Watzlawick (Watzlawick, 1996).

Besides, our look at "reality" is partial as pointed out by Simon (Simon, 1983) in his "bounded rationality". Consequently, we have to admit our inability to cover the whole field of investigation around the innovation phenomenon and also accept the emergence of unpredictability and certain incomprehension in our research.

In front of this uncertainty and unpredictability, we accustomed to see the world in a dichotomous way and to choose the one or the other way. However, repetition and solidification of these binary thinking ways seem harmful for understanding and explanation of complex phenomenon as said by Corcuff (Corcuff, 2002). In front of these binary and dichotomous representations and understanding of the reality, Edgar Morin proposed the principle of a "dialogy" which "unifies two opposed principles or notions, which apparently should push away each other but which are inseparable and indispensable to understand the same reality" (Morin and Le Moigne, 1999).

III. Innovation under the "dialogical" principle

From the various testimonies collected through out our investigations, we perceived some elements, which in first analysis appear as categorical contradictions but rather than to command to interlocutors to choose in order to raise the contradiction, we choose to consider them as appearances of the "dialogical" principle of Morin.

We identified a set of "dialogies", which are the following ones:

- Individual – Collective "dialogy"
- Opened – Closed "dialogy"
- Disorder – Order "dialogy"

[1] Term used by Larrasquet J.M. (1997) L'entreprise à l'épreuve du complexe : Contribution à la recherche des fondations du sens, Thèse de Doctorat en Sciences de Gestion, p. 248.

Although the words chosen to represent these “dialogies” oblige us to separate them when naming them, these "paired-concepts"[1] go together because they are "component one of the other and consisted the one by the other " as pointed out by Foucault (Foucault, 1996).

These « paired-concepts » at first sight seems tobe paradoxical but it is necessary to consider them in a concomitant way, to carry a view according to the first term, and a view according to the second, but especially to interest to their coexistence and their interaction modes.

In this article, we limited ourselves to these three “dialogies” although it is probably possible to list others (Informal-Formal, Process-Result, Emotional-Rational …). This choice can be justified because this “dialogies” are particularly structured in collected comments with respect to innovation dynamics.

Individual – Collective “dialogy”

Individual – Collective “dialogy” is an element to be taken into account to better understand certain emergent elements in innovation phenomenon. Indeed, the perpetual interaction (and the representations and perceptions that are linked to it) between what occurs at the individual level compared to what produces in interaction with others create synergies favouring the emergence of innovative ideas but also allows the confrontation of the opinions notably concerning the feasibility of the proposed options.

Thus, it is important to consider these two dimensions in their interaction. We often consider that idea appears at the individual level but it needs exchange at a collective level to mature and evolve. Thus, it is essential to coordinate and encourage these interactions and exchanges.

Open – Closed “dialogy”

The "Closed" dimension brings a feeling of security, which is produced by the faith to be guided on the good road, the road dictated by a leader and that serves as a support in front of the uncertainty. The "Open" dimension relates back to freedom and to autonomy with insecurity and unpredictability in order to go out of a pre-established frame and to look for the novelty.

It would be necessary "to open" to let appear ideas and to be listening to what takes place around but at the same time to be conscious that it is necessary "to close" by structuring these ideas to reach an objective more or less defined. The main question, which is certainly complex, is how to favour the interaction between these two dimensions.

Disorder – Order “dialogy”

Another representation of the innovation dynamics can be described by the *Disorder – Order “dialogy”*. It expresses the idea of movement and construction in innovation.

The "Disorder" dimension relates back to the idea of evolution, of progress and process not controlled; in a state of "boiling" allowing the emergence of new ideas. Whereas, the "Order" dimension refers to focussing on coherence and capitalization of knowledge in order to favour the regulation of the innovation process. It needs protocolising, formalizing and characterizing the ideas and the options proposed by the interveners.

IV. Learning

With this approach by the socio-cognitive functioning of the organization, we are dealing with the field of competence acquisition and development, and representations’ evolution. We are thus fundamentally in the field of learning as far as we consider it as a kind of transformation of one’s representations; “learning for an individual is fundamentally the construction of new knowledge and know-how, i.e., the modification of its representations” (Larrasquet and Franchistéguy, 2000).

[1] The concept “paired-concept”, proposed by Bendix R. and Berger B., refers to a couple of concepts, which tends to show the social world in dichotomic way.

Therefore, a kind of learning for acquisition such "socio-cognitive" skills and know-how allowing a better approach to complex phenomenon is necessary in order to improve innovation management. Basically, it is an evolution of mental representations of the person towards new a knowledge (which the acquisition is generally considered as positive) "It is a generated and generative process of connections aroused between different elements: information, cognitive processes, culture, values, action…" (Amezketa, 2006).

V. Conclusion

In this article, we wanted to highlight the innovation dynamics complexity by considering the "dialogical" principle.

To comprehend this complexity intrinsic to the innovation is an essential stake for the perpetuity and the development of organizations. In our point of view, the management should be interested in this question and should develop in the various interveners' in charge of such innovations and changes (project leaders, leaders, managers, middle executives, etc.) "socio-cognitive" skills required in such perspective in particular those, which allow the consideration of the innovation dynamics according to the "dialogical" principle evoked in this article.

This relates back to the question of learning of these skills that constitutes an important base for the understanding and thus managing in a better manner the innovation phenomenon.

Indeed, this "dialogical" view on the innovation dynamics allows developing ability "to systems thinking". This system vision allows managers to anticipate actions, identify the possible hard points, and so integrate project results into the final company's product.

At the end, the challenge concerns the "implementation" of the "dialogical" principle. Let us remind that these various "dialogical" aspects present the capacity to be brakes or control levers according to the way they are approached. Thus, they can favour or annihilate the innovation process. They ask to be followed in a sort of "performance indicators". Therefore, it will be necessary to well-define a set of indicators of monitoring and convergence of project by measuring the presence of these "dialogies" in order to bring the necessary actions by the managers.

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What bananas and Albert Einstein have to do with reliable, consistent innovation

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Keywords: Innovation, reliable, bananas, Albert Einstein

Abstract:

What do bananas have to do with Albert Einstein? More than you think.

I'd like to suggest Dr. Sam Kogan of GEN3 Partners, a product innovation consultancy, as a speaker at ERIMA '07. Jérémy Legardeur suggested that Dr. Kogan's presentation might be suitable during a 20-minute session at ERIMA or during the "Next challenges for innovation" workshop. Dr. Kogan believes that companies today need to think about innovation in a new way to survive and thrive.

The need to innovate is more important than ever. Globalization has flattened the playing field, weakening the value of brand names and forcing U.S. businesses to look to innovation for a competitive edge. To thrive, they must be able to consistently innovate. However, most businesses think of innovation as a creative process by which new ideas spring from brilliant people like Albert Einstein or even Bill Gates. As a result, they invest millions on creative consultants to jumpstart the innovation process, with uneven results.

Companies today can't sit around waiting for lightning bolts of inspiration. A one-time flash of creativity might grab headlines for a day or boost sales for a quarter, but long-term business success requires a process of innovation that is reliable and consistent.

Dr. Kogan believes companies need to look at innovation in a new way. By identifying the features of a product that customers want and are willing to pay for, companies can set up processes that produce consistent, predictable innovation – not a one-time burst of inspiration.

Here are reasons why this new approach to innovation is needed:

- Companies in lower-wage economies have huge advantages over European and U.S. firms including lower labor costs and government subsidies. The only way Western companies can compete is to be consistently more innovative.
- Innovation spreads rapidly around the world now. A company that comes up with an innovation may make a one-time splash, but before long everyone else has adopted that innovation. The company has to keep innovating consistently and predictably.
- Brands aren't all powerful any more. The Internet allows people to share experiences about a company with millions of others. People now choose the best, most innovative products, not just the best-known brands.

Dr. Kogan has been working in innovation consulting for more than 25 years. He holds a Ph.D. from the Institute of Macromolecular Science, Leningrad, Russia and a Master's degree from Polytechnic University in Leningrad. His work to bring about predictable product innovation has been adopted by some of the world's best-known companies including Proctor & Gamble, Honda, Motorola, Chiquita and Alcoa.

In fact, Dr. Kogan and GEN3 Partners are working right now on an innovation project that will be of practical interest to every one of your conference participants – or at least, every one who has ever eaten a banana.

Chiquita, the world's largest banana distributor, is redefining its image. For 107 years, its bananas have been sold in bunches at supermarkets to appeal to families. Now for the first

time, they're being sold individually at convenience stores and gas stations to appeal to single "on-the-go" people. These "Chiquita-to-Go" bananas will be sold in 7,500 convenience stores across North America by next month. A traditional family staple is now a quick-pick convenience item.

GEN3 Partners made the change possible, helping a traditional fruit distributor become an innovative, forward-looking company. After Chiquita presented its innovation challenge, GEN3 scoured dozens of industries and found a new plastic packaging that allowed Chiquita bananas to "breathe" and stay ripe for a week instead of three days. GEN3 found the packaging in the pharmaceutical industry, of all places.

In the past, convenience stores typically did not carry Chiquita bananas because they did not sell enough of them before the bananas grew overripe. Thanks to the new packaging discovered by GEN3, the change allowed these stores to store bananas at the perfect ripeness for longer. That created a new sales channel for Chiquita bananas in a venue in which they had never been sold before. Selling them individually instead of in bunches allowed Chiquita to charge twice as much per banana, increasing the company's profitability and providing access to an untapped market of "on-the-go" convenience store consumers who previously had bought mostly candy bars and cupcakes.

This real-life case study provides proof of Sam Kogan's philosophy that successful innovation today doesn't derive from a genius like Albert Einstein. Instead, long-term business success today requires a process of innovation that is reliable and consistent.

IMP³rove[1]: a *European project to develop and to test better services in support of innovation management in SMEs*

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Keywords: innovation management, self-assessment tools, innovation performance, innovation benchmarking, innovation experience sharing, Small and Medium sized Enterprises (SMEs)

I. Abstract

For the past 15 years of intensive public support towards Innovation Management Techniques (IMT) has raised four major challenges in the European Union, in line with the conclusions of the VERITE network[2]:

- *Does it make sense to measure innovation management performance in enterprises by using self assessment tools (SAT)?*
- *Will comparisons, at managing innovation processes between peers, give Small and Medium Enterprises (SMEs) more autonomy at improving their innovation processes?*
- *Can public and private innovation facilitators benefit from such innovation metrics to provide services more effectively, in order to create a sustainable increase in innovation management performance?*
- *What is the adoption model required for building a "Sustainable Community" of innovation intermediaries sharing the project results (SAT and consulting services)?*

The IMP³*rove* consortium[3] aims at responding to the above challenges: the answers are based on worldwide past experiences at measuring innovation performances and providing innovation support to a very wide spectrum of enterprises (in terms of industry sector and company sizes).

Firstly, SME managers are aware of the complexity of innovation processes. Yet, they very often lack techniques in tracking their innovation management performance due to several root causes:

- *In private enterprises, there is no correlation between R&D investments and innovation successes[4], thus showing the complexity in bringing novel ideas to market applications*
- *Innovation is indeed a complex today still unstable process, when compared to more stable manufacturing, marketing or sales activities*
- *Innovation is a process which requires more and more cross functional team work and interactions/collaborations through the whole value chain*
- *The apparent randomness of idea generation brings people to consider innovation failures as just a consequence of risk taking and consider success as being, very often, out of the enterprise's control*
- *The dynamics of research and innovation processes show that "speed", from invention to, at least a financial break-even, remains a key success factor still[5]*

The IMP³*rove* consortium is convinced that European SME managers will adopt a European system for innovation metrics, provided that they feel confident in a so-called "benchmarking approach", such as, the one implemented by large industrial groups within the European Foundation Quality Management (EFQM) model. During 2007, 1500 SMEs managers are scheduled to join the IMP³*rove* project in combination with pioneering innovation management consultants (IMC).

[1] The present work is fully funded by the European Commission (DG Enterprise service contract ENTR/05/003)

[2] " Virtual Environment for Innovation Management Technologies" , Final Report , 2004

[3] The *IMP³rove* consortium is led by AT Kearney with Advansis, APRE, Fraunhofer IAO, IAGO Ltd, i.con. innovation GmbH, IpL, Logotech, Technofi, Zabala

[4] *B.Jaruzelski et al., Strategy+ Business, Issue 41, Winter 2005, p 40*

[5] P.Devalan « L'innovation de rupture, clef de la compétitivité » Hermés Lavoisier (2006)

Secondly, measuring the performance of innovation management remains a controversial issue. Single innovation projects encompass indeed several processes of a company, e.g.: innovation strategy development, idea generation, RTD tasks to reach demonstration prototypes, manufacturing validation, launch or after sales support including the continuous improvement of the innovative products or services. The Innovation management process must, therefore, be approached **within a holistic framework.**

The IMP³*rove* consortium has developed a European Self Assessment Tool, combined with an integrated consulting process that involves innovation management techniques (IMT), available via a unique Web Based platform (www.europe-innova.org and www.improve-innovation.eu). Both set of tools rely on:

- *past expertise gained in this area in Europe and beyond,*
- *probing techniques combined with a holistic, pragmatic framework that addresses the real life issues of industry players*
- *an open architecture with harmonized contents describing innovation methodologies*
- *preventing rather than curing innovation management process defects, which require making enterprises become more aware of the main innovation barriers in a global economy*

Thirdly, the long term adoption, by intermediaries **and** enterprises, of the integrated, holistic consulting approach using the SAT requires the build up of a critical mass of service providers in Europe: it is this critical mass of expert users that will generate a pull by communicating positive results with sustainable economic impacts originating from the IMP³*rove* initiative. However, SME managers remain reluctant to call for outside expertise on innovation, as shown by the EOS Gallop Innobarometer 2004 (EC DG Enterprise):

- *only 26% of the innovative enterprises in the EU have used external services for their innovative activities in the past two years,*
- *among those who used external services, 60% took advice exclusively from private consultants, 20% exclusively from players supported by public funds, and 20% from both with little differences in company size.*

The adoption model for the IMP³ rove approach relies on a train-the-IMC approach, delivered to candidates willing to participate as innovation facilitators. Constant monitoring of the new service effectiveness is performed and creates **"Learning by Doing"** open communities of innovation service providers. Such communities will increase their capabilities at addressing the many facets of innovation management processes throughout Europe. They are capable to customize the solutions to be implemented by SMEs, based on referenced tools and methodologies available on the Web platform: they can face the diversity of industry sectors with their specific competitive environments, company sizes, regional cultures and languages.

In this present paper, a description of the whole new consulting process involving the SAT is given, together with the preliminary results of a field test involving more than 70 SMEs that took place in Finland, France, Germany and Romania on early 2007. It is shown that the development work will lead to operational tools likely to overcome three of the main expected barriers at the beginning of the IMP³ rove project:

- *The **rejection** of a European tool by national or regional experts: an expert panel assisting the consortium has helped built a collective European conviction at improving innovation processes using the proposed tools,*
- *The **difficulty** of measuring innovation performance in SMEs: the ones joining the project are selected on a size and sector basis, allowing innovation indicators to be used effectively*
- ***Possible barriers** in transferring innovation management tools to innovation facilitators, since they may be reluctant to interact with SMEs without using their own specific approach. The Web platform uses an open architecture able to exchange lessons learnt and the best in class experiences under the umbrella of an integrated modular consulting methodology suited for SMEs*

More SMEs and innovation management consultants are, of course, invited to join this large scale European approach dedicated to developing and testing better services in support of innovation management in SMEs

Worker's Commitment and Manufacturing Innovation

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Keywords: Innovation, Complexity, Learning, Autonomy, Dialogue

I. Abstract:

The presentation will describe how workers' commitment and participation has been secured in the re-organisation of a previously centralised manufacturing unit in autonomous production units.

This reorganisation was part of the implementation of a new strategic managerial system decided after a merger. The merged companies were equivalent in size, were situated in two different regions of France, comprised 4 distinct manufacturing plants, and had very different cultural, managerial and ownership roots. The merged group totals 800 people.

After the merger three main concerns were addressed:

1. Aligning the merged group on a shared vision: this was obtained through a democratic process to which the whole workforce was invited to participate. Working groups representing the workforce diversity were in charge of the process' organisation and with synthesising, liaising with management, and communication of the outcomes. The process resulted in the formulation of purpose, core values, long term vision and strategy, and was then translated with everyone's involvement into a specific identity and objectives for each production unit.

2. Reflecting and deciding a company-wide innovation strategy in order to ensure the sustainability and performance of the group and its entities. The innovation was prioritised and situated at three levels:

    a. Innovating in managerial strategy and business model;

    b. Defining 5 key competences and setting up 5 multidisciplinary and cross-functional autonomous working groups for targeting, achieving and maintaining long term excellence in each of these key competences;

    c. Defining 5 distinct strategic businesses and appointing pairs of Directors to define dedicated strategies and ensure implementation in each of these Strategic Business Units, in the medium and long term.

3. Reorganising the largest and most ancient factory of the group around the key concept of "sustainability and performance through autonomy"

It is the launch of this third intervention, currently in implementation phase, which will be described in more details. The link to the overarching change strategy and with the prior actions will be described. The importance of grounding such a profound and radical change in shared vision, shared values and purpose will be shown. In addition, the key role played by Mental Models in the successful implementation of profound change will be highlighted.

A Methodological note:

1. **Working with outsiders and co-creation of the interventions:** The interest of continuous co-creation of the intervention, with all parties interested, will be explained. Concentrating on the process, and adapting this process to changing circumstances, has been a key to overcome several unexpected events that inevitably occur as a result of, and independently from, the change process. The value added of neutral outsiders in accompanying such processes and the different roles such outsiders can/are required to play will also be shown.

2. **A learning intervention:** Such intervention is destined to ensure that the organisation evolves sustainably and positively. The importance of actively involving all persons affected by the process will be shown. In order to allow every person to project and position himself into the new organization it is of uttermost importance to combine the intervention with an action learning process. Such action learning processes should be voluntary, autonomously managed, strategically conceived and designed in teams. It is based on the theories of Nonaka & Takeuchi, Cunningham and Senge & Scharmer.

3. **Organisation as a living system:** The organisation is viewed as a complex, dynamic, non linear system. It is also interacting with an equally complex environment. Hence any intervention, even the most trivial, comprises imprevisible, sometimes hidden and delayed effects. Sustainable organisations are considered to be those able to sense and integrate weak signals and quickly and flexibly exploit for the better the ever changing circumstances. Such an organisation develops itself by ensuring value to all interested parties. The methodologies used are inspired by complexity theory (see for example Tracey, Shaw and Griffith)

4. **Large Scale Interventions and worker's involvement:** Commitment and participation of all actors is obtained by integrating the philosophical underpinnings of Appreciative Inquiry (Cooperrider) and several Large Scale Interventions Methods (i.a. World café, Open Space, Future Search)

5. **System Intelligence and overcoming systems of holding back:** It will further be shown how overcoming organisational barriers can be achieved by revealing and relying on the systems intelligence of all people involved according to the breakthrough thinking of Raïmo Hämäläinen and Esa Saarinen.

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The European project SMMART (System for Mobile Maintenance Accessible in Real Time)

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Keywords: Maintenance, transport, information system

Abstract:

1. Purpose and objectives

The SMMART integrated R&D project was launched in November 2005 and is planned to run for 3 years with an overall budget of around 25 millions €, co-funded by the European Commission.Coordinated by TURBOMECA, the project involves 25 companies and institutions from across Europe. The participants includes industry leaders (VOLVO, TURBOMECA, EUROCOPTER, SNECMA SERVICES, THALES), Small & Medium Enterprises who contribute 38 % to the project, and 6 research centres.

The SMMART project aims at defining a new integrated concept to answer the maintenance challenges of the transport industry – aeronautics, road transport, marine transport:

- To reduce the time and cost for scheduled and unscheduled maintenance inspections of increasingly sophisticated and complex products.

- To remotely provide the adequate up-to-date information to assist the mobile workers in all their tasks wherever they operate.

- To minimise the cost penalties of unscheduled downtime on large transport fleets.

2. Project key challenges

- To monitor in real-time the usage and maintenance data throughout the lifecycle of critical subassemblies of a vehicle.

- To optimise maintenance management through a world-wide network.

- To provide new services: advanced troubleshooting tool, global configuration control, resources planning tool.

- To remotely exchange information between all life-cycle stakeholders in a timely, secure and trusted environment.

- To provide end-to-end visibility of the logistic supply chain.

- To improve industrial and logistic traceability.

- To optimise maintenance and logistic planning.

- To further improve transportation safety.

Project technical approach

The innovative approach of the SMMART consortium is based on the combination of new technology wireless sensor network and smart tags capable of operating and communicating wirelessly in the harsh environment as on a vehicle's propulsion unit to monitor the usage and maintenance data throughout the life-cycle of critical parts and provide secure end to end visibility of the logistics supply chains.

Data are then processed in a database.

Innovative software functions associated with business process change will enable European companies to offer new, more flexible and customised support and logistics' services for the transport industry.

This approach implies the development of a multidisciplinary approach combining technological, organisational, management and social aspects in order to propose a global business process reengineering for the SMMART solutions implementation within the end-user community.
End-Users companies of the consortium are representative of the aerospace, automotive and marine sectors. These companies participate to general specification, project design reviews and evaluation of the developed solutions so as to ensure that the outcomes of the SMMART project are reused and become a normative solution.

Supporting the Systemization of Early-Stage Innovation by Means of Collaborative Working Environments

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Abstract

Research in the area of the early-stage of innovation concentrates on non-linear innovation environments constituted by the nature of the "fuzzy front end" of innovations in which there are no well-defined problems or goals at that point in time.

Requirements of the early innovation phase are the general applicability and the possibility of iterations of the innovation environment to be developed. The research presented in this paper focuses on innovators needs in today's and future working environments to provide a highly flexible software solution supportive of early stage innovation. The adaptability of the environment for the users and the fulfilment of requirements will be achieved by a framework based on innovation related methods aggregated to activities and workflows which constitute iterative processes. As early stage innovation is seen in the actor-network theory (Allan 2007) as a social process the participation of individuals will be encouraged by the usage of game dynamics to support idea generation related workflows.

Innovators are not necessarily located in one place. Bringing the right people together independent of time, place and personal relation will be achieved by connection mechanism also supported through game approaches being developed.

The integrated software solution will support and guide innovators to get connected to the right people, produce ideas based on explored knowledge and evaluate them to achieve the goal of developing successful innovations. The approach presented in the proposed paper is basing on the work carried out by the European funded research project Laboranova.

Keywords

Collaborative working environments, innovation, early-stage innovation,

1 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 organisations 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.

2 Theoretical Background of Early-Stage Innovation

Innovation can be understood as the process where something new and valuable to a society is created and an economical effort can be made off. Ideation as part of the overall innovation

process is the “ability one has to conceive, or recognize through the act of insight, useful ideas” (Vaghefi 1998). Therefore ideation represents a process with ideas as a result.

Innovation is defined in many different ways. There seems to be a consensus on the following points:

- Innovation is not identical to invention, the main difference being that innovation covers the whole process from a new idea to a realized product or process available to potential users or customers,
- Innovation is a result of a number of intended actions, and not just the spontaneous nearly evolutionary development of new products and processes,
- Basically innovation is related to change and the emergence of something new – and not only new but in some respects better (thus innovation is often seen as a form of problem-solving), Innovation can be based on adaptation and evolution, but is not identical although a series of spontaneous adaptations can appear as an innovation,
- Innovation is closely connected to economic growth and to improvements in life-quality.

Latest developments in theory give a view from a sociological perspective on innovation and the change from a linear process — from research to innovation — to a user centric approach where the technological research and the sociological aspects of innovation are addressed equal. Also strategic management and innovation are no longer seen as a linear approach than as a parallel development. Innovation can be seen as a kind of learning/knowledge process in a community of practice. Supportive to the learning effect in the field of innovation is the visualisation which needs to fit the cognitive needs of users. With respect to the new character of innovations the visualisation must be very clear to all stakeholders in the innovation. This causes different kinds of visualisation to fit the different requirements of the diverse stakeholders.

The organisational requirements in the field of innovation show the same development direction as mentioned in the theoretical part. The user centric approach is becoming more and more important to organisations.

Moreover organisations can better utilise their internal resources better by making the implicit knowledge of employees available for the organisation. Approaches in this field are the so called skunk work where 10 - 20 % of the working time is dedicated to employees own projects.

3 An Approach for the Systemization of Early-Stage Innovation

Within this paper an approach to systemize and support early-stage innovation is presented. The “fuzzy front end” of innovation is the key to the success of an innovation project. Idea generation is often seen as the inspiration or intuition of an individual represented in the “romantic innovation theory” (Weisberg 1993). But idea generation can also be seen as outcome out of a work process not related to an individual but to a group of people working together in a network. Innovation takes place more and more into distributed teams where collaborative working environments support users.

Existing Collaborative Working Environments (CWEs) mainly focus on supporting traditional working paradigms of linear workflows by providing IT-based platforms for planning, scheduling and executing tasks. However, in order to achieve continuous strategic innovation and thus create persistent competitive advantage, organisations need to increase their capacity for carrying out open-ended and nonlinear problem solving involving a wide participation of people in knowledge-rich environments. This must be supported by the next generation CWE’s, which in turn, requires new paradigms for managing the knowledge transfer, the social dynamics, and the decision processes involved in the front-end of innovation. This will be supported by the usage of game dynamics in knowledge creating processes in order to enhance collaboration and boost creativity and innovation.

Because of its fuzzy nature, where details and even goals are not defined exactly the early stage innovation can not take place in a linear process. Iterations are the nature of the related workflows. Traditional project management is all about linearity. But in the early stages of innovation, one rarely has a well-defined problem, and so iterations between problem, solution and possibilities are needed.

With respect to these facts the actual research in the field of early stage innovation focuses on the real requirements of innovators in distributed working environments and the solving of the occurring challenges.

As mentioned earlier ideation is seen as a work process, as something that can be planned and managed, rather than as a result of a rare creative capacity that is mobilised suddenly in inspired individuals.

Considering ideation as a work process, it makes little sense to view ideas as something one gets. They are something one creates, an expected result of a lot of hard work, where the involved minds become prepared to recognize the new. New input is gathered, existing truths are questioned, mental models are created and recreated, again and again, until – often perceived as suddenly – thoughts fit and ideas emerge.

The development taking place in field of innovation methodology is based on an approach with individual methods and tools aggregated to consistent activities and workflows. These aggregation levels constitute iterative processes in the early stage innovation. The collaborative working environment is going to support this work. It will develop explicit routines for team based ideation work, together with a technological infrastructure that allows for communication about, and experimentation with more or less finished ideas, early stage innovations and concepts not yet realised.

The network of people working in the field of idea generation neither are not necessarily located in one place, even not in one company, nor do they work in one time zone. New connection mechanisms need to be developed and implemented to bring the right people together who share a specific interest. As much as participating in the idea generation process the motivation of individuals is to key for success.

But creating connections is not only a matter of bringing the right people together. Connections provide the backbone for ideation. They can be instantiated between ideas to describe the intellectual lineage of an idea (e.g. where it is coming from) or to keep together related ideas. Connections transform a collection of ideas into a structure that can be browsed and filtered according to innovators' needs.

Even if the right individuals and the right ideas have been brought together and a quantity of ideas are generated in the provided environment, there are differences in the quality of ideas and the chance of success later within the market launch. In order to select the ideas which have the greatest chance of becoming a successful innovation evaluation is necessary. To achieve this goal the "intelligence of many" will be used by implementing a prediction market into the innovation environment.

4 Conclusion

To support early-stage innovation in distributed teams Collaborative Working Environments (Hribernik 2007a/b) need to be developed which support non-linear work processes. These iterative processes will be described by an integrated methodology which is based on the aggregation of methods and tools to activities and workflows fulfilling the innovators needs.

The overall goal is to provide an innovation environment which can be used easily; where innovators see the advantage of usage and by using it enhance the environment in its quality.

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