JIM
Journal of Innovation Management
The International Journal on Multidisciplinary Approaches on Innovation
Volume 2 Issue 1 | open-jim.org

ISSN 2183-0606
FEUP Edições

Journal of Innovation Management
JIM 2, 1 (2014) i-iv

Table of Contents

Editorial

Letters

Articles

ISSN 2183-0606
http://www.open-jim.org

Technology and Science / Industry

From Knowledge-Driven Creation to Society-Driven Innovation: Some Glimpses on Organizational Ambidexterity, Open Innovation and Value Creation

Innovation lies at the heart of value creation, growth and competitiveness, and receives accrued attention in times of economic turbulence and slowdown. Organizations currently face increasingly dynamic environments and challenging conditions, which leave them exposed to higher levels of complexity and uncertainty. Thus, the ability of organizations to reinvent themselves and to reposition their offerings is critical for their survival. Permanently nurturing this ability to innovate is an essential role for managers and innovation leaders. In this issue we embrace different facets of this ability, and consider it at multiple levels: individual, organizational and inter-organizational. The two Letters featured in this Issue also reflect this multiplicity of levels needed to comprehend, and support the innovation process. In the first Letter of this Issue, Molina contends that value creation from science can be achieved through the astute combination of "knowledge driven creation" and "society driven innovation". He further argues of the need for scientific research to address key challenges facing humanity, and to unleash its transformative power on society. This message echoes with the philosophy of this Journal, as connecting academic research with pragmatic reality is embedded in its DNA.

The inter-organizational collective level is debated in the first Letter from Standardization published in the Journal of Innovation Management. Standards' role on the innovation process is still largely debated as they have been simultaneously reported to act as catalysts for innovation activities and to prevent and hamper the development of novelties by constraining and restricting creativity and original thinking. Zelm illustrates the usefulness of engaging into a standardization process at the early phases of a research project. The concomitant action between research and standardization is depicted as having positive effects on interoperability, on avoidance of misconceptions and misunderstanding, and on the diffusion of novelties.

Defining the individual skills and competencies to mobilize in the innovation process, as well as characterizing organizational capabilities to astutely configure, combine and reconfigure resources in view of developing novelties remain topical managerial challenges. Organizational ambidexterity, a central concept in organizational theory gaining increasing popularity in technology and innovation management, is conceptually debated and empirically investigated in this Issue. In their conceptual paper, Hafkesbrink and Schroll discuss the individual competencies, as well as the organizational antecedents and competencies needed to achieve simultaneously exploration and exploitation in the specific context of open innovation processes. Their contribution further elaborates a framework to understand the educational needs of industry to engage into the open innovation journey, thus providing food for thought for educational bodies and policy makers alike.

Suzuki's empirical contribution explores the interplay between the exploration-exploitation dilemma, problemistic search, deliberate learning and speciation. Organizational ambidexterity is modeled as a continuous variable, and is derived from factual and objective information, in contrast to mainstream research operationalizing the construct using several items for which managers' perceptions are collected. Furthermore, Suzuki's analysis enables time lag effects to be captured in a fast-moving business environment, thereby addressing typical limitations of cross sectional studies. The scholar concludes that firms may boost their degree of organizational ambidexterity by resolving, rather than circumventing, the typical

ISSN 2183-0606
http://www.open-jim.org

dichotomy between exploration and exploitation.

The contribution by Hieltjes and Hieltjes present a case study on the implementation of open innovation in the consumer electronics industry. Inbound open innovation activities are crystallized in this paper through the reliance on three ecosystems - knowledge, experience and legislation/certification – which interact with the stage-gate development of novelties. The influence of standardization is also unveiled in this paper, thus resonating with the standardization letter and departing from the view that innovation and standardization are oxymoron.

Tüten et al. explore other key components of the economy: SMEs. In their empirical paper, the scholars reveal the role of entrepreneurial team characteristics, mainly age heterogeneity and average education, on organizational innovativeness of SMEs. Furthermore, the scholars uncover potential substitute effects between average education and networking.

The final paper of this Issue by Nicola et al. proposes a model for decomposing and assessing value customers, adopting a multi-polar perspective of the concept of value network analysis. The model is applied in the footwear industry, where it shows its usefulness for supporting the managerial decision-making process. In doing so, the scholars exemplify how academic research can contribute to frame, shape and support the innovation process in businesses, thereby connecting new knowledge creation to societal needs and challenges.

Wishing the Readers an enjoyable innovation journey,

Innovatively yours,

João José Pinto Ferreira, Anne-Laure Mention, Marko Torkkeli
Editors

Letter from Academia

From Science to Value Creation – Researcher Perspective

Arturo Molina

Tecnologico de Monterrey
Avenida Eugenio Garza Sada 2501 Sur
Colonia Tecnologico
66297 Monterrey Nuevo León, México
phone: +52.55.9177.8281
armolina@itesm.mx

Abstract. A proposal to create value from science is presented. The main challenge is to balance two approaches: “knowledge driven creation” and “society driven innovation". The future for scientific research will be placed in the ability of the research community to be able to address these two paradigms to create both new knowledge and disruptive solutions for the society needs.

Keywords. Scientific research, action research, innovation, education, value creation.

1 Introduction

It has been recognized that science and technology create value for society as well as its economic and social development (Geisler 2001). However, when discussing this issue with members from industry, government and academia, the question always arises: Why do we need scientific and technological research? How can we measure its real value within a society? Ordinarily, the objective of scientific research is the generation of knowledge without necessarily having the goal of knowledge transfer to have an impact on society. There is a need to propose a new paradigm where we, the researchers, carry out our important task of creating knowledge, but also to connect this knowledge for the benefit of our society. My opinion is that scientific research should be used to add value to a society in a faster and more measurable manner. I believe that there are three ways for this to be accomplished: 1) Research to improve education; 2) research to achieve innovation; and 3) research to transform society.

2 Some Thoughts

Let me share my thoughts with an explanation and examples. Research is a key cornerstone of education as there is a need to continuously evolve scientific and technological knowledge in our learning process. Of course knowledge generation allows us to keep our education and technical knowledge updated. However, the real challenge is to understand from a scientific perspective how the learning process is evolving and how the new generation of youngsters (e.g. Millennials) are, by osmosis, modifying the learning paradigms. Therefore, educational models and technologies are always changing. Examples of these new approaches are MOOCs (Mass Open On-line Courses), Learning technologies (Augmented and Virtual Reality), serious gaming, challenge oriented learning, to mention just a few. Are we really preparing

ISSN 2183-0606
http://www.open-jim.org

the next generations to face even bigger challenges? Are we helping them to develop the right skills and competences? Are we using the right technologies to achieve a truly educated population, worldwide? The challenge here remains open: how could scientific research create value in order to achieve a more educated society in a global world, regardless of their social and economic reality?

The connection of scientific research to the innovation process is always an endeavor. Linking contributions of fundamental research to an outcome, with measurable social benefits, has been a major discussion at forums and conferences. However, an innovation process is better sustained by scientific research because it provides for the realization of all the innovation activities (i.e. research, development, technological, organizational, financial, and commercial) with a great deal of novelty using a scientific approach; such as action-research, experimental based, and data-proof. The idea is to achieve four types of innovation in a competitive manner product and services, process, organizational and marketing (Oslo manual 2005). Research is fundamental to innovation; an innovation process is a driver for research activities: the push and pull approach. Research on Bio-Info-Nano-Cogno is creating accelerating technologies to innovate, for example: Artificial Intelligence, Robotics, Biotech, Nanotech, smart medicine, neuroscience, sustainable energies and resources, and computing. All these technologies will contribute to groundbreaking innovations to digitize the world, create products on demand and processes, and democratize knowledge, product and services. Therefore, science, technology and innovation will continue to add value to society. The challenge is to enable a virtuous connection to bridge knowledge generation with value creation.

3 Conclusion

Finally, scientific research should transform society. There is an imperative that the researchers should link scientific training and production to find solutions to the most defiant problems humanity is facing: water, energy, environment, food security, global health, education, sustainable growth and poverty. Researchers have access to global knowledge and solutions that can be applied to their local context. Open research and innovation models are key to address these difficulties with a sense of community, collective knowledge and capacity to act. Why do we look the other way instead of addressing these challenges? The phrase “publish or perish” is well known. However, we must take our responsibility to deliver solutions to society in order to really create value within our communities. How can we achieve value creation in our research in a more straightforward manner? My proposal is to combine two research approaches: “knowledge driven creation” and “society driven innovation”. As researchers, we have a responsibility towards value creation based on our scientific research that addresses society´s demands. But we also have to advance scientific knowledge to create new concepts, theories, and paradigms to progress the comprehension of the world and universe. Let’s also change our mind-set while training our undergraduate, master, PhD students and Post-Doctorate researchers so they can connect to the humanity necessities. It is the time to change our vision and commit to one that will allow the transformation of our society based on scientific research. Let’s not miss this opportunity: Research to educate, innovate and transform in order to transcend in this lifetime, so far… there is only one opportunity.

4 References

Geisler, E. (2001). *Creating value with science and technology*. Greenwood Publishing Group.

Organisation for Economic Co-operation and Development. (2005). Oslo manual: Guidelines for collecting and interpreting innovation data. OECD publishing.

Letter from Standardization

Towards standardization during research – the Service Modelling Language

Dr. Martin Zelm

Coordinator Standardization Group, INTEROP- Virtual Laboratory, Brussels (www.interop-vlab.eu)

martin.zelm@t-online.de

Abstract. Research and standardization are often considered concepts that exclude each other or follow one another with a time distance of years. On the other hand standards can be very beneficial to ease all kinds of interoperability problems in and between enterprises to integrate system components. Since based on consensus between many stakeholders, the time to develop standards is high. The article presents an example of early involvement in standardisation of product related services in Future Manufacturing Ecosystem during its research and development phase in the European project MSEE.

Keywords. Product related services, Service Modelling Language, Manufacturing Ecosystem.

1 General Requirements

The vision of Future Manufacturing Ecosystem in the European Manufacturing Service Ecosystem (MSEE) project (MSSEE 2010) is focussed on the principles of systems engineering and enterprise modelling in cooperating enterprises. These are the most important ones for the development of innovative products or services. The MSEE project develops a framework for modelling a Service System, which is supported by languages to build such models. These models will guide production innovation and reduce the costs arising from miscommunications and misconceptions in cooperating organisations with proprietary solutions for their information systems. Such problems can best be resolved by using international standards, since they insure worldwide consensus and interoperability.

However usually standardization follows research with the distance of several or even many years, which then faces the situation of the availability of many incompatible products and the resulting problems in interoperation. To insure early availability of such standards, standardization efforts have to start in the research phase of any product development. This practice is used in the MSEE project where research and standardization evolve almost in parallel.

The current situation is that there is no language standard (ISO and CEN) for the modelling of a service system in Manufacturing (MSEE D742, 2013 and Chen 2013). Some existing service modelling languages focus on IT related services or Web services. On the other hand, most existing enterprise modelling languages are relevant to model services in the Virtual Manufacturing Enterprise (VME), and this means that they can be reused to model part of a service system in the context of VME.

ISSN 2183-0606
http://www.open-jim.org

2 Framework and modelling methodology for services

The MSEE project proposed that standardization would start early during the research phase, thus enabling the benefits of fast standardization for the whole community stakeholders. The Model Driven Service Engineering Architecture (MDSEA) developed in the project is adopted for the global modelling of Service System. The architecture is based on Model Driven Architecture (MDA) and Model Driven Interoperability (MDI) and enables the modelling the three types of service system components - IT, Human and Physical Resources (Chen et al 2012, Chen 2013). MDSEA can be considered as an adaptation and an extension of MDA/MDI to the engineering of product-related services in virtual manufacturing enterprise environment

The proposed multiple-part standard specifies requirements to model services both within and between operational environments of manufacturing enterprise. It defines a Service Modelling Language (SML) for the design and implementation of service systems in a Virtual Manufacturing Enterprise environment. The Model Driven Service Engineering Architecture (MDSEA) acts as a framework for the proposed service modelling language.

Architecture Standards used for SML

- MDA – Model Driven Architecture, an open, vendor neutral framework developed in the Open Management Group (OMG 2008)
- MDI: Model Driven Interoperability; A definition is given at ATHENA IP (2010)

3. Service Modelling Language

The proposed Service Modelling Language (SML) developed in the MSEE project, (MSSEE 2010) is concerned with the operational interworking of manufacturing enterprise processes and the interoperability of supporting software applications. The language starts with the user view at the Business Services Models (BSM) level focusing on the aspects of business process, decision-making and information. It prepares for the link to the software development to make the models executable via transformation of models between the modelling levels.

SML is defined by a set of modelling concepts/constructs with identified interrelationships between the constructs. Construct(s) can be represented by: (a) graphical representation, (b) template description, and (c) text. A template will contain a header part to identify a construct instance, and a body part to describe the particular instance with descriptive and relationship attributes (Chen 2013)[r]

The advantage of the SML is the capturing of the perspective of the business user by modelling services in the context with business processes, activities, decision making. This orientation towards the business user (enterprise engineer, designer) represents the main benefit compared to other approaches of modelling service messages or the interchange of services. On the other hand the MDSEA approach is rather complex and requires a number of models, in different languages, as well as model exchange between the model levels.

This standard would apply to manufacturing enterprises but can also be employed in other classes of enterprises. It is intended for use by IT and research specialists who are concerned with developing and deploying IT-based solutions for manufacturing enterprise process interoperability.

The proposed Service Modelling Language (SML) is using several modelling

language standards of CEN, ISO and OMG described by Chen (Chen 2013). In particular, EN/ISO 19440, (Enterprise Integration – Constructs for Enterprise Modelling), to model process, resource and organisation, as well as CEN/ISO 11354: "Requirements for establishing manufacturing enterprise process interoperability". Further inputs may come from a comparison and mapping with the upcoming OMG standard "Value Driven Modelling Language" (Berre at al 2013).

Besides the development of the SLM specification, three industrial pilots have been set up to demonstrate the technical feasibility as well as the Modelling Language business benefit for the service oriented ecosystem. Such industrial pilots are presented during a number of industry workshops during the MSEE project. The validation of the SML is still an on-going activity.

4. Concluding Remarks

The Service Modeling Language (SML) is presented as an example of exploring standardization while research and validation of the service modeling concepts are ongoing. The orientation of SML towards the business user (enterprise engineer, designer) represents the main benefit compared to other approaches of modelling service messages or the interchange. There is no language, international standard, for the modeling of service system. The technical approach of MDSEA builds on the combination and reuse of several existing architectures and models, in different languages, as well as on model exchange between the different modelling levels.

5 References

Berre, A., De Man, H, Lew, Y., Elvesaeter B.,Ursin-Hoolm, B., Open Business Model, Process and Service Innovation with VDML and ServiceML, (2013) *Proceedings of the IWEI 13 Workshops*, 127-144, ISTE-WILEY, London

Chen, D. (2013). Service Modelling Language and Potentials for a New Standard, *Proceedings of the IWEI 13 Workshops*, 107-114, ISTE-WILEY, London

Chen, D., Ducq, Y., Doumeingts, G., Zacharewicz, G. and Alix, T., A model driven approach for the modelling of services in a virtual enterprise, (2012), *Proceedings of I-ESA'12 International Conference*, 181-187, ISTE-WILEY, London

MDA - *The Architecture of Choice for a Changing World (2008)*, Accessed 15th March 2010 . http://www.omg.org/mda/

MDI: *Model Driven Interoperability, ATHENA IP, (2010)*, Accessed 15th March 2010, http://www.modelbased.net/mdi/

MSEE *Manufacturing Service Ecosystems project, (2010)*, Accessed 15th March 2010, http://www.msee-ip.eu

Report on MSE standards (2013), MSEE Deliverable D74.2, Accessed 13rd November 2013, http://www.msee-ip.eu

Ambidextrous Organizational and Individual Competencies in Open Innovation: The Dawn of a new Research Agenda

Joachim Hafkesbrink

RIAS e.V. – Rhein-Ruhr Institute for Applied System Innovation, Bürgerstr. 15, 47057 Duisburg, Germany.

jh@rias-institute.eu

Markus Schroll

Innowise GmbH; Bürgerstr. 15, 47057 Duisburg, Germany.

ms@innowise.eu

Abstract: This paper describes a conceptual approach to individual and organizational competencies needed for Open Innovation (OI) using a new ambidexterity model. It starts from the assumption that the entire innovation process is rarely open by all means, as the OI concept may suggest. It rather takes into consideration that in practice especially for early phases of the innovation process the organization and their innovation actors are opening up for new ways of joint ideation, collaboration etc. to gain a maximum of explorative performance and effectiveness. Though, when it comes to committing considerable resources to development and implementation activities, the innovation process usually closes step by step as efficiency criteria gain ground for a maximum of knowledge exploitation. The ambidexterity model of competences for OI refers to these tensions and provides a new framework to understand the needs of industry and Higher Education Institutes (HEI) to develop appropriate exploration and exploitation competencies for OI.

Keywords: OI; Exploration; Exploitation; Ambidexterity; Organizational Antecedents; Individual Competencies; Organizational Competencies

1. Introduction

This paper brings together research in Open Innovation (OI) with research in organizational and contextual ambidexterity. Since Henry Chesbrough introduced the term Open Innovation a decade ago (2003), a huge body of conceptual and empirical work has been conducted in this area to understand e.g. the drivers, mechanisms, tools, organizational antecedents and success criteria of opening up the innovation process. Already a decade before laying the ground for the OI paradigm, the scientific discussion about balancing explorative and exploitative activities in firms started, having its origin in the seminal work of James G. March (1991). He pointed out capabilities of how to manage the tensions between exploration and the exploitation of resources in the innovation process and in organizational learning. However, up to now, the links between OI and ambidexterity are not researched in depth, though there is at least casuistic evidence on a strong mutual interaction between these two research agendas, e.g. widening the relevant management dimensions of OI (see. Stoetzel and Wiener, 2013), identifying different styles of culture and leadership as important organizational antecedents of OI (Brem and Viardot, 2013).

In this paper an ambidexterity model of OI is presented based on earlier work of the

ISSN 2183-0606
http://www.open-jim.org

authors on organizational antecedents, contextual ambidexterity and individual competencies for exploration and exploitation (cf. Hafkesbrink et al., 2013) and as well on organizational competencies for OI (cf. Hafkesbrink and Schroll, 2010a). Special emphasis is laid on two distinct aspects of this symbiosis: (1) organizational antecedents and competencies for exploration and exploitation and (2) individual competencies for exploration and exploitation in the OI process. The aim is to provide a heuristic framework for developing a curriculum on OI Competencies for HEI, reflecting the needs of industry to drive effective and efficient innovation processes.

On this background this paper is organized as follows: in the following chapter two a short overview is presented on the current discourse on OI and on the ambidexterity debate. Chapter three provides the conceptual linkage between the OI and the ambidexterity model. Organizational competencies are described for the core tasks of exploration and exploitation in the OI process. On this background chapter four presents an in-depth set of hypotheses for organizational antecedents as well as organizational and individual competencies for OI based on a literature review and an ambidexterity model for OI. Finally chapter five presents a short summary as well as an outline of a new research agenda on ambidextrous competencies for OI.

2. Open Innovation and Ambidexterity

2.1 Open Innovation

OI usually is defined as the targeted opening of the innovation process to include external knowledge such as of customers, suppliers and research institutes etc. into the innovation process (outside-in) with the aim to successfully implement new products or services on the market and/or to exploit own knowledge via collaboration with third parties (inside-out), e.g. by way of licensing (cf. Hafkesbrink and Schroll 2010a). Here an important contribution to this new way of thinking innovation processes was made by Henry Chesbrough. He stressed that, in short, OI focuses on how to combine different competencies or technological capabilities, whether they are inside or outside the firm, and apply them to commercial ends (cf. Chesbrough 2003 and 2004; Lazzarotti and Manzin, 2009).

Such opening processes first require a change in thinking and in strategy: wasn't it – hitherto – confidentiality being the credo of all innovation activities, e.g. by hiding product development as long as possible from the competitors to achieve time savings in the market launch? Thus, such opening processes also require a specific "constitution" of the organization: what does "opening of organizational boundaries" in everyday life mean – does it mean clear communication from the inside out on whatever competition-related topic? The transition from closed to OI is shown in fig. 1:

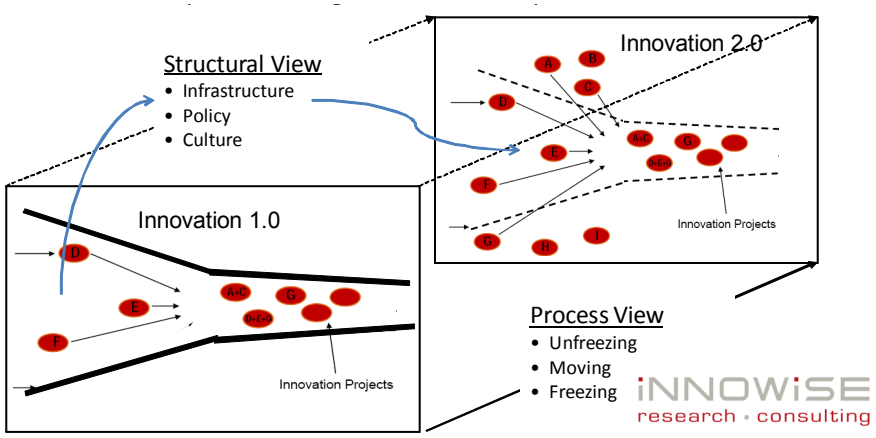


Fig. 1. Transition from Closed to OI (Source: Hafkesbrink and Scholl 2010)

To step from "Innovation 1.0" as the archetype of a closed innovation model towards "Innovation 2.0" as the new OI model, a paradigm shift in certain constitutive elements of the organization is needed (structural view). This embraces unfreezing existing infrastructure-, policy- and culture elements of the organization, moving to new institutional arrangements, by, for example, configurating trials, working in a new way, developing trust and commitment and subsequently refreezing them so as to enable new organizational competences and stability to emerge in the next stages of organizational development (cf. Lewin 1948).

Findings of numerous empirical and theoretical studies now show (at a glance cf. Hafkesbrink and Schroll, 2010a) that, for opening up the innovation process, especially in the phases of idea generation and design, there is a need for more exploratory forms of organizational design to provide a maximum of flexibility and knowledge absorption in the innovation process. This in particular includes cultural openness, dynamic adaptability of the structures and processes, IT-support, networking skills, collaboration capability beyond organizational boundaries and the ability to identify new knowledge and technologies (see fig. 2).

In contrast, for later phases of the innovation process rather exploitative forms of organizational design are needed, which ensure an efficient exploitation of new knowledge. Thus, product development and production are more dependent on reliable and stable organizational structures that are used to retain obligations and routines. In this respect, less the appropriation, but rather the transformation and exploitation of knowledge are central organizational performance factors.

According to figure 2, empirical evidence in the literature reveals that organizations which can manage both modes of organizational design, are able to adapt more effectively and efficiently to changing environments (Güttel and Konlechner, 2007; Tushman et al. 2002). Obviously, this so called 'ambidexterity' produces relevant trade-offs between those phases of an innovation process where flexible adaptation to new ideas, designs, moods etc. ("De-compressive Openness") is necessary with those phases of the innovation process that need straight-forward management ("Compression Mode") (cf. Eisenhardt and Tabrizzi, 1995). Figure 2 suggests that there is a strict line separating explorative from exploitative modes, organic from mechanistic structures, stable from flexible phases, heuristics from routines etc. Of course in reality, we may experience a specific composition of these ambidextrous modes depending on the single innovation case, sector, environmental dynamics,

community communication channels, learning requirements etc.

Characteristics of Ambidextrous Organizations		
Implementation Mode	explorative	exploitative
Structural Mode	organic	mechanistic
Adaptation Condition	flexible	stable
Rules	heuristical	routinized
Decision Making	implicit leadership	explicit leadership
Communication	lateral	vertical
Governance	advice and learning	desicions by superiors
Control and Authority	network and trust	hierarchy

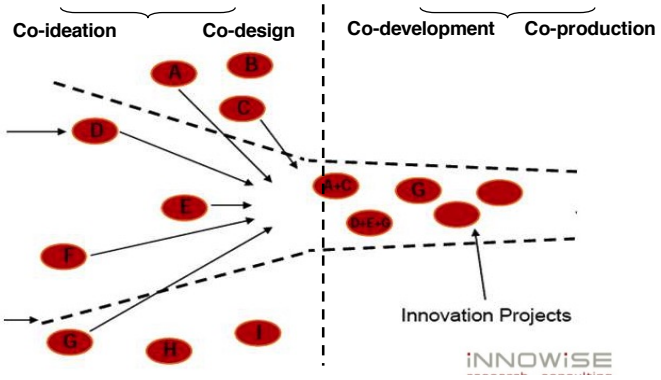


Fig. 2. Characteristics of ambidextrous organizations in the OI Process (Source: Hafkesbrink et.al., 2011)

This sheds light on different facets of organizational learning in the context of OI:

First, it seems obvious that in the context of OI the organization must learn both incremental and radical (Perkins et al., 2007, p. 306). Even in the opening up process it has to rely on existing structures that determine e.g. the borderlines and self-organization capabilities of the organization, on cultures that rule e.g. open-mindedness, reputation and trust and the knowledge friendliness of the organization. But OI also requires radical learning in terms of changing the rules of the game: intellectual property rights, non-disclosure principles, historically evolved hierarchies etc. may be in need for change radically if an organization would like to benefit from open knowledge collaboration.

Second, it appears quite clear that in OI organizations also have to learn both on an individual/cognitive and a social/cultural level (Perkins et al. ibid). There are important links between the learning of organization members when solving problems and learning on the superior organizational level, understood as the capacity of an organization to transform its underlying structures, cultural values, and objectives in response to, or in anticipation of, changing environmental demands (cf. Argyris and Schon, 1996). "Hence, a learning organization depends on openness to new ideas and change at both the individual and organizational level" (Perkins et al. 2007, p. 307).

2.2 Ambidexterity

Ambidexterity is usually defined as the ability to develop and utilize new resources

and competences (resources exploration) and at the same time make efficient use of already available resources (resources exploitation). A very general definition is given by Bledow et.al. (2009): *"We define ambidexterity as the ability of a complex and adaptive system to manage and meet conflicting demands by engaging in fundamentally different activities. On the most general level ambidexterity implies successfully managing the dichotomy of explorative variability creation and exploitative variability reduction"* (Bledow et al., 2009, p. 31).

The term 'ambidexterity' was introduced by Duncan (1976) into innovation and organizational research to describe the ability of a firm to build dual organizational structures, on the one hand for the creation of innovation and on the other hand, for the implementation of innovation (so-called 'Dual Structures for Innovation'). Organizational ambidexterity in this context means the ability of an organization to create a sustainable organizational capacity through balancing resources exploration and resources exploitation (cf. March 1991, Tushman and O'Reilly, 1996). In this context organizations have to make choices considering the principal scarcity of resources: "Organizations make explicit and implicit choices between the two" (March 1991, p. 71), which at first glance assumes a trade-off between these two modes of resource use (ibid., p. 72 f.). However, recent research shows that there also may be synergies between resource exploration and exploitation instead of trade-offs: „On the other hand, exploitation and exploration are considered to be mutually enhancing, so that it is possible for firms to attain high levels of both" (Gupta et al., 2006; cf. Jansen et al., 2006). Both modes of the relationship between exploration and exploitation under the 'scarcity of resources paradigm' are depicted in the following figure:

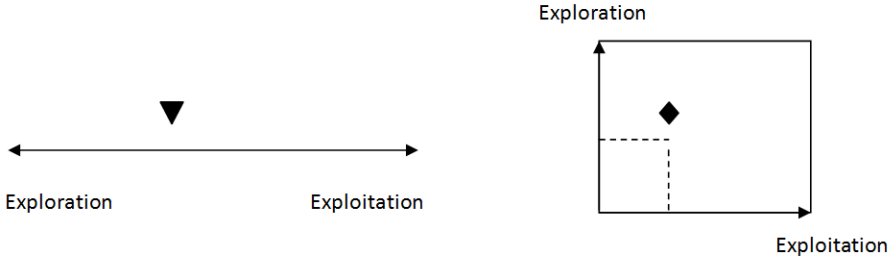


Fig. 3. Relationship between exploration and exploitation

The left part of figure 3 describes two ends of a continuum and involves the assumption of a trade- off between resource exploration and exploitation. Limited by scarce resources only a certain level of activity of either exploration or exploitation can be achieved, thus there exists a trade-off between the two activities ('Conflict School', i.e. dichotomous approach that stresses the fundamental contradictions between exploration and exploitation). The illustration on the right part of figure 3 states that exploration and exploitation may relate orthogonal to each other (so-called 'Complement School', starting from the assumption that exploration and exploitation tolerate each other (see Hobus and Busch, 2011, p. 189 ff.).

The terms 'exploration' and 'exploitation' are connoted with a plurality of features. On a very general level, exploration refers to 'the discovery of new possibilities' and exploitation to the 'valorization of existing potentials' (cf. Stephan and Kerber, 2010, pp. V). "While exploration processes aim on the search for new knowledge, for unknown technologies or diversifying into uncertain new product markets, exploitation means the recovery or refining of existing enterprise resources, for example through deepening of knowledge, incremental innovations or differentiation of the product range" (ibid. translation by the author).

Mirroring the tensions between exploration and exploitation, also innovation research reveals that innovation processes can be characterized principally by a variety of stresses (cf. Lewis et al., 2002), paradoxes (cf. Miron et al., 2004), contradictions (cf. King et al., 1992) and dilemmas (cf. Stoetzel and Wiener, 2013; Benner and Tushman, 2003; Bledow et.al., 2009, p. 4). Thus, from the perspective of innovation research, the terms 'exploration' and "exploitation' play the following central role: 'exploratory innovations' require new knowledge and leave familiar knowledge domains (cf. Benner and Tushmann, 2003, p. 243). „Exploratory innovations are radical innovations and are designed to meet the needs of emerging customers or markets" (Benner and Tushman, 2003, p. 243, see also Danneels, 2002). ‚Exploitative innovations', however, are incremental innovations to meet the needs of existing customers. They broaden existing knowledge, improve existing designs, expand existing products and services and improve the efficiency of the distribution (cf. Abernathy and Clark, 1985; Benner and Tushman, 2002; Tushman and Smith, 2002; Levinthal and March, 1993). In this context Tushman and O'Reilly (1996) define ambidexterity as the „ability to simultaneously pursue both incremental and discontinuous innovation" (Tushman and O'Reilly, 1996, p. 24).

3. Linking Open Innovation and the Ambidexterity Model

Figure 2 already gives a hint to how OI is linked to ambidexterity. Going more into detail, interrelationships are more complex and need to be described more in-depth. Thus figure 4 provides an outline of the elements, the subsistent relationships, the survey marks and operational items of the ambidexterity model (cf. Hafkesbrink et al., 2013). The model is based on a contingency-based approach to organizational adaptation (cf. Burns and Stalker, 1961; Lawrence and Lorsch, 1967, Miller and Friesen, 1983), assuming that ambidexterity and its organizational and individual enabling depends on context factors like environmental dynamics and complexity (cf. Auh and Menguc 2005), and that the main driver for switching between exploration and exploitation as alternative modes of learning is environmental change. At the same time, the model is based on a multi-level analysis: ambidexterity may not only arise at an organizational level but also at an individual, team or inter-organizational level (cf. Kaupilla, 2010; Simsek, 2009, p. 605; Hobus and Busch, 2011, p. 192). Furthermore, multiple interdependencies are anchored within the model, focusing on (a) reciprocities between organizational design and individual competencies development, leading to a loop between individual and organizational learning, and (b) amplifying and/or compensation effects between organizational design dimensions and performance criteria (cf. Simsek, 2009, p. 607). Finally, the model raises the question as to how single organizational design dimensions and individual competencies contribute to single exploration and exploitation performance criteria:

The basic hypothesis of our model is that ambidexterity for OI develops as the result of:

- a specific configuration of organizational antecedents which are specialization, coordination, formalization, (de-)centralization, leadership styles and organizational culture (cf. Jansen et.al., 2006; Gibson and Birkinshaw, 2004);
- a specific configuration of professional, methodical, social and personal competencies to support exploration and exploitation activities within the organization (cf. Hafkesbrink and Schroll 2010a).

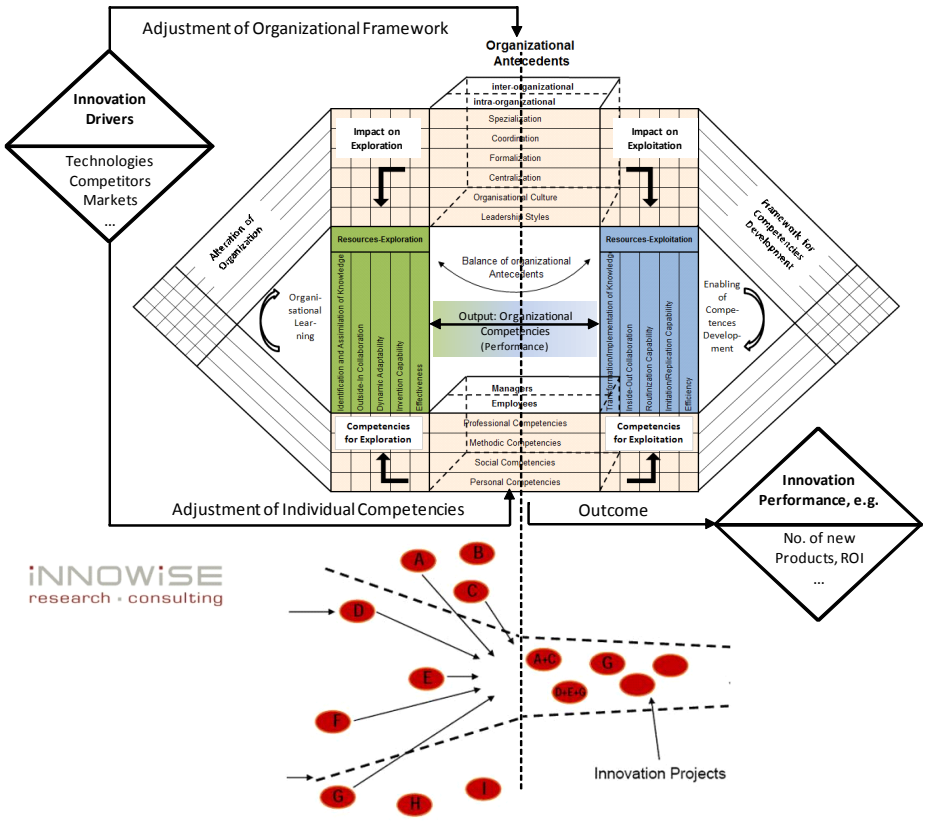


Fig. 4. Ambidexterity Model of OI

The following interdependencies are considered to be important for the ambidexterity model (see fig. 4):

- the model assumes that firms adjust their organization to new requirements, e.g. to OI, from the firms environment (independent variable, contingency variable) by altering the organizational antecedents (response variables I) mentioned above within organizational change processes;
- the model also implies that individual competencies of managers and employees are adjusted to these new requirements by altering professional, methodical, social and personal competencies (response variables II) within personal development and training processes;
- alterations in the organizational framework may also impact individual competences development, i.e. it may enable or impede individual competencies acquisition (moderation effect between response variables I and II);
- individual learning cumulates along the team level up to the organizational level introducing organizational learning;
- alterations of organizational antecedents and individual competencies directly impact the performance of exploration and exploitation (dependant variable);

- organizational competencies (dependant variable) are composed of exploration- and exploitation performance criteria; these are (1) for exploration: identification/assimilation of knowledge, outside-in collaboration capability, dynamic adaptability, inventive capability, and effectiveness; and (2) for exploitation: transfer/valorization of knowledge, inside-out collaboration capability, routinization capability, imitation/replication capability, and efficiency;
- overall innovation capability (e.g. measured by the number of successful products or ROI) is the outcome variable (dependant variable) of the model;
- finally the ambidexterity model assumes that resources exploration is applicable to the early phases, resources exploitation applicable to the later phases of the OI process.

Considering of what has been argued so far and looking on organizational competencies it becomes quite obvious how the ambidexterity model is linked to the OI process (extract from fig. 4):

Dimension	Exploration	Exploitation
Knowledge management/ -absorption	Identification/ assimilation of knowledge	Transfer/ valorization of knowledge
Collaboration with external partners	Outside-In collaboration capability	Inside-Out collaboration capability
Stability/ organizational learning	Dynamic adaptability	Routinization
Innovation process	Inventive capability	Imitation/ replication capability
Performance	Effectiveness	Efficiency

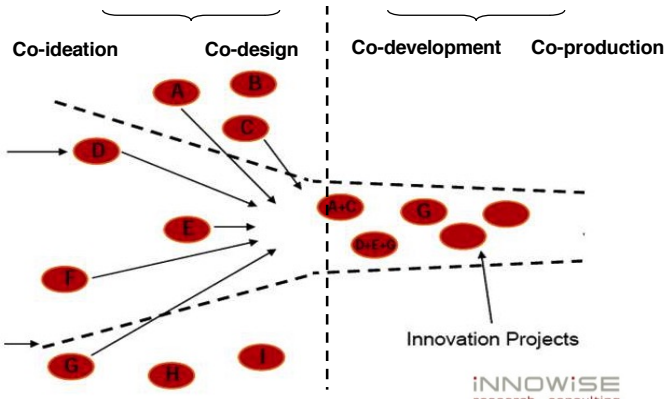


Fig. 5. Linking Organizational Competencies for Exploration and Exploitation to the OI process

4. Organizational Antecedents, Organizational and Individual Competences for Open Innovation

In the following chapter we will first describe the ***organizational competencies*** for OI

more in-depth, following the main dimensions of exploration and exploitation, displayed in the above fig. 5. Then we will turn to the ***organizational antecedents*** that moderate these organizational competences in one way or the other. Finally we will draw on ***individual competencies*** for OI, since the innovation process is always driven by humans and their personal, social, methodical and professional competencies.

4.1 Organizational Competences and Antecedents for Open Innovation

Organizational Competencies for the Exploration of Resources.

Ability to identify and assimilate knowledge: For OI exploration, it is decisive to establish capabilities for the identification of technological and market-based options that are relevant to the company (cf. Mortara et al., 2009), and the ability to evaluate and to build compatibility with the company's existing expertise (cf. Schroll, 2009; Schreyögg and Kliesch, 2002; Boscherini et al. 2009; Cohen and Levinthal, 1990; Mortara et al., 2009). In the literature, this part of the acquisition of knowledge is referred to as 'potential absorptive capacity'. "Potential absorptive capacity, [...] includes knowledge acquisition and assimilation, captures efforts expended in identifying and acquiring new external knowledge and in assimilating knowledge obtained from external sources" (Zahra and George, 2002, p. 189). It may make a difference whether the source of knowledge is of academic or industrial nature (cf. Vega-Jurado et al., 2008), thus 'scientific absorptive capacity' and 'industrial absorptive capacity' are distinguished: "The former is a firm's ability to absorb scientific/technological knowledge from universities, technology institutes, and public and private research centers; the latter is its ability to assimilate and exploit knowledge from actors in the industry chain. The factors that determine the development of these types of absorptive capacities is different although in certain sectors they may be complementary" (see p. 11). The ability for the identification and acquisition of knowledge can be measured by how successful the organization identifies and acquires relevant knowledge from external sources (i.e. knowledge for the purpose of new problem solutions in the company).

Ability for Outside-in Collaboration: Outside-in collaboration is about the ability to build solid communication and working relationships with the appropriate external sources of knowledge and expertise in order to support the identification and acquisition of knowledge (cf. Hafkesbrink and Schroll 2010a). In addition to the known groups of partners in the innovation process such as suppliers and consultants, the OI debate has directed attention to crowdsourcing communities, i.e. working with customers to generate ideas for new products and services (ibid.) or with other communities of practice, of affinity, of knowledge (cf. Evers and Hafkesbrink 2010; Hafkesbrink and Schroll 2010b). The sustainability of these communication and working relationships can be operationalized by the sum of the tightly and loosely coupled connections (cf. Granovetter 1983; Andriopoulos and Lewis 2009, p. 704) to the corresponding market partners. It is a question of both building formal structures of relationships, for example in the context of strategic alliances, as well as informal social relationship structures that provide access to 'tacit knowledge' (cf. Hess and Rothaermel, 2008).

Dynamic adaptability: The term Dynamic Adaptability ('Dynamic Capabilities') refers to so-called 'double-loop (or second-order) learning', i.e. changes in values, structures and processes in the organization, with the result of profound organizational changes as a precondition to OI (cf. Helfat et al., 2007). "(The) Key to understanding dynamic capabilities, therefore, is the organization's ability to alter its resource base in a repeatable and reliable fashion, as guided by the organization's strategic intent" (Hess and Rothaermel, 2008, p. 1 f). Dynamic adaptability can be operationalized by various indicators to assess if the organizational structure, the

organizational culture and the management/strategy system are able to establish a 'fit' between changing environmental conditions and internal contingency factors on the one hand (e.g., size, age of the organization) and organizational structures and processes on the other hand.

Inventive capability: In the context of exploration activities, the initial utilization of new knowledge in the form of idea generation and development activities for the creation of something new plays a central role. The creative ability which leads to inventions or in general to new potential problem solving (cf. Middendorf, 1981) can be referred to as 'inventive capability'. This inventive capability comprises examining and experimenting as well as the so-called 'mental transgressions' in connection with the approach to new knowledge. "Boundary transgression refers to mental moves that cross the boundaries of past practice and convention, tying together academic disciplines in unexpected ways, redefining not only means but often the problem itself, and challenging entrenched beliefs about the limits of the possible" (MIT 2004, p. 9). The inventive capability can be operationalized by indicators such as the 'number of beneficial ideas', 'number or functionality of prototypes', the 'feasibility of a concept' etc. The inventive capability may be enriched by using well known OI tools for creativity enhancement, idea orchestration etc.

Effectiveness: The term effectiveness follows the paradigm of goal orientation (cf. Scholz, 1992), i.e. organizations are 'effective' in the context of a predefined goal (e.g. satisfaction of stakeholders): "Organizational effectiveness is an external standard of how well an organization is meeting the demands of the various groups and organizations that are concerned with its activities" (Pfeffer and Salancik, 1978, p. 11). As a measure of success for the exploration of resources, effectiveness describes colloquially the ability "to do the right things", as opposed to the efficiency of resource exploitation ("doing things right"). The effectiveness of resource exploration can be operationalized by different indicators such as 'achieving objectives in resource acquisition', 'the quality of problem solving', 'motivation and stimulation of creativity, morality, entrepreneurial freedom, participation and influence' (cf. Scholz, 1992).

Now, after we have learned about relevant organizational competencies for the exploration phase of OI, i.e. Ability to identify and assimilate knowledge, Ability for Outside-in Collaboration, Dynamic adaptability, Inventive capability and Effectiveness, we will now turn to their counterparts in the exploitation phase of OI (see again fig. 5).

Organizational Competencies for the Exploitation of Resources.

Ability for transfer/valorization of knowledge: The subsequent steps following knowledge identification and assimilation are the integration of (existing) knowledge for the continuous improvement of business processes (cf. Lazzarotti/Manzin 2009, Mortara et.al. 2009, Schreyögg and Kliesch, 2002), and the ability to utilize knowledge in the market (cf. Boscherini et al., 2009). In the literature this part of the knowledge utilization is also described as 'realized absorptive capacity', "which includes knowledge transformation and exploitation, encompasses deriving new insights and consequences from the combination of existing and newly acquired knowledge, and incorporating transformed knowledge into operations" (Zahra and George, 2002, p. 190). The ability to transform and utilize knowledge in the enterprise can be operationalized, for example, by observing the extent to which existing knowledge (including knowledge, which reached the company via a knowledge acquisition process or exploration process) is actually incorporated in new products, services or its underlying technologies, or was used to improve existing products, services and technologies (e.g. the number of own patents as a basis for the company's product portfolio).

Ability for Inside-Out Collaboration: Inside-out collaboration is about a company utilizing its knowledge externally, that is not used for its own market-based purposes (cf. Kutvonen, 2009; Kutvonen and Torkkeli, 2008; Hafkesbrink and Schroll, 2010a; Escher 2005; Gassmann and Enkel, 2004; Lichtenthaler, 2007), and establishing communication and working relationships with corresponding market partners. This kind of 'downstream or outbound utilization' is usually production and marketing-oriented and addressed to as the 'exploitation of explicit knowledge' (cf. Hess and Rothaermel, 2008). The ability for inside-out collaboration can be operationalized by, for example, the number of licenses sold, or the number and quality of exploitation alliances with third parties.

Routinization capability: In evolutionary economics routines are outlined as "repetitive patterns of activity" (Nelson and Winter, 1982, p. 97). Routines are ascribed a complexity reducing effect and, as a result, a decline in transaction costs leading to more efficiency. The actors in an organization take pressure off themselves by using routines instead of having ongoing search and decision problems. Routines are so-called 'first-order' capabilities in organizations (cf. Collis, 1994) that represent the operational core of the organization (e.g. production processes, marketing, sales). For innovation processes routines are – in the right measure – not counterproductive per se, they just must not grow disproportionally otherwise they will handicap the search for the new, and decrease the ability to manage the unexpected (cf. Bessant et al., 2010, p. 4). Thus, Comacchio/Bonesso (2011) present empirical findings on the routinization of the absorptive capacity of organizations showing that also for exploratory phases of innovation as part of the identification and assimilation of new knowledge certain routinized action sequences are beneficial (e.g. formalized trend monitoring activities), in order to survey new discoveries with implications for the company and to keep records for others to understand. Routinization capability is often described as a dynamic first-order skill ('First-Order Dynamic Capability'; cf. Zollo and Winter, 2002) that aims to improve the core processes of the organization (incrementally). Routinization capabilities can thus be referred to as an organizational competence for incrementally changing operational routines (cf. Konlechner and Güttel, 2010). They prepare the way for organizational learning and improve efficiency and effectiveness by accumulating the general adaptability of the organization (cf. Marino, 2011). Routinization capability can be operationalized, for example, by the ability to apply methods of process and project management and by their impacts on organizational reflexivity (cf. Moldaschl, 2010).

Imitation/replication capability: Imitation and replication are important processes for the utilization, or renewed utilization, of knowledge in organizations. Imitation aims for the acquisition of external knowledge; replication on the other hand, aims for the re-use of the organization's own internal knowledge (cf. Konlechner and Güttel, 2010, p. 32). The starting assumption is that routines that are used successfully in certain organizational units and that are implemented in other organizational units with a similar or identical context are equally successful (cf. Kaluza and Blecker, 2005; Winter, 1995). "Replication is about leveraging knowledge and is successful when ‚broadly equivalent' outcomes are realized by 'similar means'" (Baden-Fuller and Winter, 2005, p. 8 quoted by Konlechner and Güttel, 2010, p. 32). Replication strategies became known especially through franchise models (the so-called McDonald's approach). Organizational imitation and replication capabilities can be operationalized with the help of indicators like "quality of knowledge codification" and "quality of knowledge transfer", i.e. by an assessment of how existing (external or internal) directly applicable knowledge will be usable codified and documented for third parties e.g. through the use of templates (cf. Nelson and Winter, 1982), and how this knowledge gets to the user.

Efficiency: the term efficiency describes the operational performance of an organi-

zation as a ratio of output and input (cf. Hafkesbrink, 1986, p. 45 f.) ("doing things right"). For the organizational dimensions of the ambidexterity model different sub-efficiencies can be determined, e.g. for specialization, the 'economies of scale' (specialization advantage); for coordination, the 'achieved performance in synchronization of a process based on the division of labor in relation to the transaction costs of coordination'; for formalization, the 'benefits compared to the cost of written rules'; for decentralization, the 'comparison of decisions (quantity and quality) and spent transaction costs', etc.

4.2 Organizational Antecedents for Ambidexterity in Open Innovation.

Now, as organizational competencies for resources exploration and exploitation have been described, we will now turn to their organizational antecedents. There is a large body of literature on these organizational antecedents often describing ambivalent results of the moderating effects on resources exploration and exploitation, comprised in fig. 6:

+/-	+/-	+	+/-	+/-	low	**Specialization**	high	-	+	+	+	+
+/-	+/-	+	+	+	self-determination	**Coordination**	institutiona-lized	+	+/-	+	+	+
+	-	-	-	-	low	**Formalization**	high	+	+/-	+	+	+
+	+	+/-	+	+/-	low	**Centralization**	high	+	+	+	+	+
+	+	+	+	+	open, reliable	**Organizational Culture**	closed	-	-	+	+	-
+	+	+	+	+	transforma-tional	**Leadership Style**	transactional	+/-	+/-	+	+/-	+/-
Ressources-Exploration					**Input: organizational ressources**			**Ressources-Exploitation**				
Identification and Assimilation of Knowledge	Outside-In Collaboration	Dynamic Adaptability	Invention Capability	Effectiveness	Balance of organizational framework conditions			Transformation/Implementation of Knowledge	Inside-Out Collaboration	Routinization Capability	Imitation/Replication Capability	Efficiency

Fig. 6. Moderating effects of organizational antecedents on resource exploration and exploitation

We do not go into any detail of this matrix because it is beyond the scope of this paper (for more detailed results see Hafkesbrink et al., 2013). As a kind of summary the following brief headwords may be sufficient:

The likelihood of exploration decreases with the organization's knowledge specialization, while it increases the returns to exploitation and thus induces a commitment to it (cf. Dimov and Martin de Holan, 2005).

Coordination instruments aimed at self-determination do not support all phases of exploration equally. To identify knowledge and to support management in

collaboration with third parties in (open) innovation processes, technocratic coordination instruments are well suited. On the other hand, institutionalized forms of co-ordination are more conducive for exploitation activities (cf. Zahra and George, 2002; Szulanski and Jensen, 2006, 2008; Konlechner and Güttel, 2010).

According to Jansen et al. (2006), formalization does not decrease a business unit's exploratory innovation, but positively influences exploitation. The reason that formalization negatively correlates with exploration may be that the search for other than already-known solutions may be inhibited (cf. Weick, 1979).

For the impacts of centralization on exploration, there is evidence that a high centralization negatively moderates the explorative performance of an organization unit, and vice versa organizations high in power distance will generate high exploitative innovation (cf. Tsai, 2002). Furthermore, bottom-up knowledge and horizontal inflows of a manager will be positively related to the extent to which this individual engages in exploration activities, while top-down knowledge inflows of a manager will be positively related to the extent to which he or she engages in exploitation activities (cf. Jansen et al., 2006; Bledow et al., 2009; Mom et al., 2007).

In general, a transparent and open organization culture supports processes of resource exploration, while closed corporate cultures are especially conducive to routinization and replication (cf. McCarthy and Gordon, 2011; Jaworski and Kohli, 1993; Atuahene-Gima 2003; McFadyen and Cannella, 2004; Subramaniam and Youndt, 2005).

The debate on leadership styles mostly centers around the dichotomy of transformational and transactional leadership. Thus transactional leadership behavior is supposed to have a negative relationship with exploratory innovation, but a positive relationship with exploitation processes. Transformational leadership will be highly related to exploratory innovation when the organization's environment is perceived as dynamic; conversely transformational leadership will be minimally related to exploratory innovation when the organization's environment is perceived as stable, and vice versa. Here transactional leadership is applied (cf. He and Wong, 2004; Simsek 2009; Panday and Sharma, 2009; Jansen et al., 2009; Sosik et al., 1997).

For the OI discussion, a transformation of these findings to concrete organizational design measures is necessary that enables opening up the organization and the mindset of the people within the organization. The following table comprises a selection of these organizational design measures and their instrumental origins (as a combination of distinctive organizational antecedents):

Table 1. Exemplary organizational design measures and their instrumental origins (organizational antecedents) to cope with the challenges of OI

	Organizational Antecedents						
Organizational Design Measures towards Open Innovation	**Spezialization**	**Coordination**	**Formalization**	**Centralization**	**Organisation Culture**	**Leadership Style**	**Source**
Cross-funktional Teams	X	X			X		Lovelace/Shapiro/Weingart
Fluide project structures as knowledge		X					Hobus/Busch 2011, S. 191
Diversity to enhance different					X	X	Bledow et.al. 2009, S. 14
Development of slack resources						X	Stein/Klein 2010, S. 59-79
induced disorders, to break-up routines						X	Brunner et.al. 2009
Garbage Cans			X				Cohen/March/Olsen 1972
Job Enrichment and Job Rotation	X		X		X		Adler/Goldoftas/Levine 1999
Decentralized Structures				X			Tushman/O'Reilly
Shared Visions					X	X	Bartlett/Ghoshal 1989
Learnoriented organization culture			X		X		Birkinshaw/Gibson 2004
Dual Structures	X	X					Ducan 1976; Simsek 2009
Semi-/Quasi-Strucktures to promote		X			X		Jelinek/Schoonhoven 1993
Coexistence of Authority and Democracy, Disciplin and Empowerment,		X			X		Lewis 2000
Bridging ties to cross structural holes creating the potential for innovation.	X	X					Tiwana 2008

Thus, looking again on fig. 4, we now shared our view on the organizational antecedents for ambidexterity, especially how they are moderating distinct exploration and exploitation competencies in the OI process. We learned that there are - no wonder – different impacts of organizational design measures on the ambidextrous performance in exploration and exploitation of resources.

Now we are going to enter more or less virgin soil as we ask the question: what is the significance of individual competencies in OI and how are individual competencies to be differentiated in the OI process with respect to resources exploration and resources exploitation?

4.3 Individual Competencies for Ambidexterity in OI

The link between individual competence development and resources exploration or exploitation is still widely neglected. In the Anglo-American literature some research contributions can be found on the subject of "individual ambidextrous competences" in the background of the discussion about "contextual ambidexterity" (cf. Gibson and Birkinshaw, 2004). These contributions follow the recognition that ambidexterity is at least based on decisions and behavioral arrangements of executives and employees: "Although ambidexterity is a characteristic of a business unit as a whole, it manifests itself in the specific actions of individuals throughout the organization" (ibid, p. 211).

In the debate on individual competencies two fundamentally different work situations have to be distinguished (cf. Erpenbeck and von Rosenstiel, 2003). (1) On the

exploration side, it is about divergent self-organized processes with creative, partially or totally open goal attainment situations that often require a deviation from known patterns of action (cf. Wang and Rafiq, 2009). Here skills are required that help to enhance variety and effectiveness ("doing the right things"). (2) On the exploitation side, it is about convergent requirement-driven processes, i.e. to meet external requirements in much more familiar, experience-based situations, where it makes sense to build skills that reduce variety and support efficiency orientation.

The core challenges in exploration and exploitation to cope with in OI are displayed in the figure 7. In that sense individual competencies to cope with ambidextrous challenges of resources exploration and exploitation need to develop both:

- combinative and focussing skills in the area of professional competencies
- complexity management and variety reduction skills in the area of methodic competencies
- cooperation and hierarchical skills in the area of social competencies
- self-reflective and authority skills in the area of personal competencies:

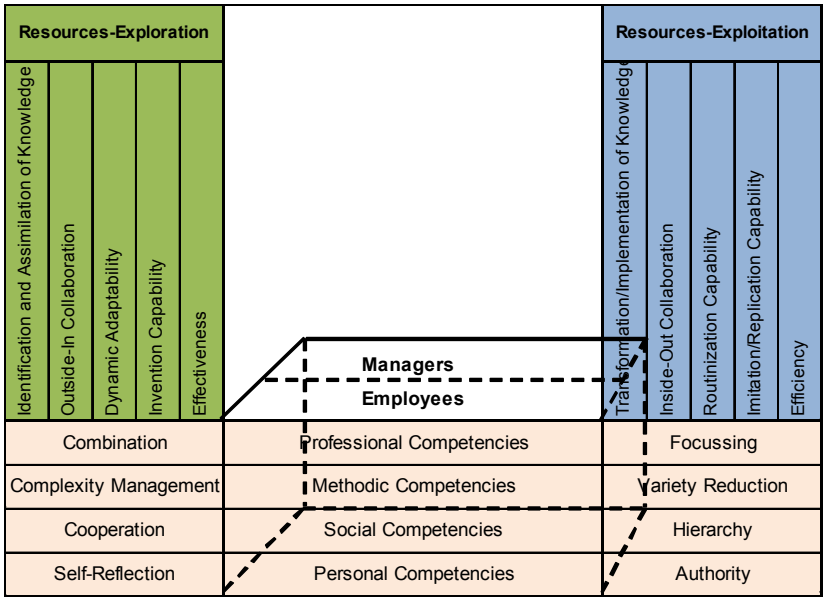


Fig. 7. Principal challenges of individual competencies to cope with in Exploration and Exploitation

In the following sections, we will differentiate these individual competencies by using the dimensions of ***professional, methodical, social and personal competencies*** (cf. Hafkesbrink and Schroll 2010a) in order to establish a heuristically more enriched system of hypotheses and to gain new insights into the relationship between individual competencies and exploration/exploitation in OI.

Relevance of Professional Competencies in Exploration and Exploitation.

Professional competencies are those skills that help to cope with typical occupational tasks and requirements based on a self-organized process, i.e. to

creatively solve problems with specialist knowledge and to be able to classify and meaningfully evaluate knowledge that is relevant for task fulfillment. Professional competencies, and their appropriation, are subject to increasing pressure for change, due to dynamic developments of technology, and the general shift from a manufacturing towards a services and knowledge society.

Professional competencies are key features in the innovation process, thus also in OI. In resources exploration, it is important to identify and translate new specialist knowledge for the organization innovation process. There the focus is primarily on the access to new knowledge, either in the form of trend reports and market studies (explicit knowledge) or in the form of so-called 'tacit knowledge' (cf. Hess/Rothaermel 2008), bound to e.g. university research personnel. On the other hand in resources exploitation it is about incrementally enriching existing knowledge with experience along a chosen technology path, with the aim to optimize the expertise based on the existing (business) processes.

On this background it seems reasonable that broad expertise is beneficial to the exploration process, as diverse knowledge for different domains and tasks is available (cf. Schudy, 2010, p. 13). In contrast, specialized knowledge is more conducive for exploitation processes because specialists dispose of a very deep knowledge in their own field and can use it effectively to apply knowledge in more or less known situations (ibid).

Professional competencies for knowledge exploration: New knowledge must be interlinked with existing knowledge. Nonaka and Takeushi (1995) refer to this as "combination". This combination works well, if the new knowledge is close to the already available knowledge. Diversified background knowledge is important because this improves the chance to relate new information to already existing knowledge. At the individual level competencies of how to combine new with existing knowledge are discussed, and are defined as methodical skills, e.g. 'gate-keeping' or 'boundary-spanning' (cf. Ansett 2004), which is especially relevant for OI. The tasks are knowledge identification (carrier, sources etc.), the translation of knowledge into a language that is understood in the organization, and the transformation and dissemination of knowledge in the organization for the purpose of exploitation etc. (cf. Cohen and Levinthal, 1990; Van den Bosch et al., 1999; Kogut and Zander, 1992; Eisenhardt and Martin, 2000; Klose, 2008; Meeus et al., 2011).

Professional competencies for knowledge exploitation: A high degree of knowledge specialization may hinder intra-organizational transformation and the diffusion of newly acquired knowledge to improve existing processes, because it causes myopia and inertia as well as a 'Not-Invented-Here' syndrome (lock-in).

Professional competencies for Outside-In/Inside-Out collaboration: Specialized expertise can effectively support processes of outside-in and inside-out collaboration particularly when it comes to cooperation with external market partners of the same professional domain. In cooperation with complementary market partners, too much specialization may hinder cooperation due to communication problems.

Professional competencies for the management of change and routinization processes: highly specialized expertise may prevent dynamic adjustment processes because cognitive lock-in processes may appear with the effect of learning inertia, learning trajectories, and the risk of core rigidities (cf. Holtmann, 2008; Leonard-Barton, 1992). Specialized expertise, on the other hand, promotes the routinization of processes and contributes generally to productivity and quality improvement.

Professional competencies for Invention/Implementation: Broad-based expertise and trans-disciplinary thinking can promote radical innovation better than specialization and mono-disciplinary thinking. Specialized expertise, on the other

hand, facilitates imitation, replication and the implementation of existing solutions.

Professional competencies for Effectiveness and Efficiency orientation: Professional T-shaped skills, i.e. the combination of specialized and general knowledge (cf. Karjalainen and Salimäki, 2008), improve the effectiveness of knowledge identification and assimilation, as the possibility of combining new and existing knowledge increases. Specialization in knowledge acquisition should also increase efficiency in knowledge acquisition (cf. Hsu, 2009).

Relevance of Methodical Competencies in Exploration and Exploitation.

Methodical competencies are defined as skills to identify, procure, process, store and use professional knowledge. They serve as a bridge in the innovation process: on the exploration side, methodical skills have to bridge the process of knowledge identification and knowledge acquisition in relation to external partners. In the transition from exploration to exploitation methodical skills have to support the assimilation and transformation of knowledge within the organization, i.e. the translation of existing external knowledge to internally understandable knowledge (cf. ter Wal and Salter, 2011; Lane and Lubatkin, 1998).

Methodical competencies for knowledge exploration are those which are awarded to gatekeeper and boundary spanners, i.e. to those innovation actors that dominate the identification, assimilation and the transfer of new knowledge into the organization (cf. Hess and Rothaermel, 2008; Rost et al., 2006). Such technological gatekeepers often act as professional promoters, i.e. they promote interorganizational exchange of object-specific expertise and make use of expertise as arguments against opponents. Thus methodical skills for knowledge exploration should enable attention to be focused on trends that increase inspiration in the innovation process, e.g. with methods such as "cross-innovation" capabilities (cf. Steinle et al., 2009), trend monitoring (cf. Hafkesbrink et al., 2010), and networking with diverse communities of knowledge (cf. Evers and Hafkesbrink, 2010).

Methodical competencies also have to enable internal assimilation of new knowledge, e.g. by applying methods of 'idea banking', the evaluation of feedback from after-sales services, through idea visualization techniques, by methods of diachronic and synchronic communication, the facilitation of 'Team Enabling Spaces', etc. (cf. Commacchio and Bonesso, 2011). Thus methodical skills such as abstraction (e.g. abstracting from individual case studies), analysis and planning (e.g. to be able to interpret trends), decision-making and judgment (e.g. to evaluate the significance of a trend for the company), the mastery of research techniques (e.g. to produce variety), strategic thinking and acting (for the evaluation of action sequences) and well-structured thinking (about the systematization of knowledge acquisition) are at the center of knowledge exploration.

Methodical competencies for knowledge exploitation must support the usage of knowledge with respect to customers and external exploitation partners. They must be able to bring the knowledge internally to the right place, to apply knowledge in products, services, or processes in the organization itself and to ensure secure protection against loss of knowledge. Hence, it is about the methodical support of horizontal or vertical intra-organizational knowledge flows (cf. Xiong, 2011), for both tacit and explicit knowledge. In intra-organizational knowledge transformation the following play an important role: diplomatic skills (e.g. switching between R & D and production and sales); capabilities to integrate opinions and media/presentation skills (to 'sell' new ideas within the organization); facilitation skills (e.g. to lead cross-functional groups) and problem solving, project management and reorganization skills play an important role.

Methodical competencies for Outside-In/Inside-Out Management must be able to support cooperation with technology and market partners upstream (i.e. towards

suppliers of knowledge, technologies, etc.) and downstream (i.e. towards exploitation partners). Upstream cooperation is often about collaboration with universities, research institutes or other technology suppliers, where it is mostly about the handling of implicit knowledge (cf. Hess and Rothaermel, 2008, p. 5). In OI, the management of 'inbound processes' for the absorption of available community knowledge is also relevant (cf. Hafkesbrink and Schroll, 2010), as is technology-sourcing (cf. Van de Vrande et.al., 2009), crowdsourcing and lead-user involvement (cf. Baldwin et al., 2006). In contrast, downstream cooperation is primarily concerned with the exploitation of the organizations own explicit knowledge, which is passed on to external partners via licensing or other exploitation rights (cf. Teece, 1992). Methodical skills for the Inside-Out management have to support the following tasks in the so called 'Outbound Process' (cf. Savitskaya and Torkkeli, 2009; Lichtenthaler, 2008): planning of exploitation opportunities; identification of the technology environment of the company and of exploitation partners; negotiation of collective partnerships and cooperation agreements; implementation of technology transfer (patent licensing, copyright transfer, joint ventures, etc.); and controlling the contract situation.

These tasks can be supported by specific methodical skills that - apart from professional expertise to evaluate technologies – may enable the inbound and outbound process effectively, e.g. analysis and planning skills (preparation of Make-/Buy- or Keep/Sell- decisions), diplomatic skills (in negotiations with external partners in the market place), ability to judge and decide (e.g. in Make-/Buy- or Keep/Sell-decisions), networking skills (for the establishment and maintenance of a network of partners in technology purchase or technology marketing), project management skills (for the implementation of Inbound-/Outbound projects), research techniques (for obtaining market information), strategic thinking and acting (for the impact evaluation of Inbound-/Outbound projects).

Methodical competencies for change management should enable a change agent to prepare and perform dynamic adjustments of the organizational structure, organizational culture and management strategy. The objective of change management is the creation, expansion or modification of the organizations resource base (cf. Hess and Rothaermel, 2008, p. 1). According to Lewin (1948), change processes occur in three stages: Unfreezing - Changing/Moving – Re-Freezing/Keep Moving. These phases are influenced by two organizational context factors, namely 'drivers' (impelling forces) and 'restraining forces' (preventing forces). During 'Unfreezing', existing organizational structures or cultures have to be thawed, employees have to be convinced of the necessity of change, etc. Here it is important to strengthen the drivers for change - e.g. through the implementation of specific incentive schemes and forms of participation – in order to overcome barriers. During 'Changing/Moving' processes and structures have to be reorganized and re-institutionalized on a level higher ('Refreezing'). To this end, different methodical skills are important especially to handle increased variety in change processes such as abstraction and judgment capabilities (for the promotion of rational insight), change management competencies (for the change agent), ability to integrate opinions (to promote decision-making in team structures), moderation-/mediation competencies throughout the change process (for conflict resolution).

'Refreezing' means at the same time the institutionalization of new rules and the setting up of routines, for the developed, maintained altered state organization, at least temporarily (until a new cause for organizational change) is stabilized. For, 'Refreezing', the following methods can be effective skills to routinization, allowing the stabilization of the new state (or the new regime), e.g. abstraction and modeling capabilities (to control rule development and for the design of routines), analysis and planning skills (fitting of the routines in the organizational processes and structures),

change management competencies (for the change agent), problem solving and well-structured thinking (in terms of the institutionalization of new processes and structures), project management skills (to control organizational development projects). Methodical competencies for routinization must therefore be aimed at the promotion of experiential learning in the new regime, on binding the knowledge in form of routines in the organization and in business processes, and in assisting production focus and goal achievement (efficiency targets) (Bledow et al., 2009, p. 9). Thus they should be directed towards decreasing variety.

Methodical competencies for Inventions/Implementation: Invention is at the core of exploration processes. It requires creative skills that lead to inventions or generally to new problem-solving potential (cf. Middendorf, 1981). It belongs to the so-called "fuzzy front-end activities" in the innovation process, where initial individual or group-based learning processes take place (cf. Val-Jauregi, 2006; Stevens and Soparnot, 2007). Methodically it is about supporting the processes of discovery, idea generation, idea evaluation and concept definition, which may, in the end, lead to an invention (cf. Cooper and Kleinschmidt, 1995). In times of increasingly OI, also issues of co-ideation and co-creation (cf. Hafkesbrink and Schroll 2010a) are also discussed, i.e. the concerted creation of new ideas and problem solving potentials together with external innovation partners. Methodical skills for fuzzy front end activities must support the management of a non-sequential process because invention processes are often interactive, iterative and dynamic. The methodical tools to aid the process of idea generation (thus increasing variety) include e.g. 'Six Thinking Hats' (cf. de Bono, 1990) or development tools such as 'House of Quality' (cf. Akao and Mazur, 2003).

Besides methodical skills such as: abstraction skills (e.g. progressive abstraction as a creativity technique; Schlicksupp, 1999), analysis and planning skills (for structuring invention processes), ability to judge and decide (for support during evaluation processes), R&D project management skills (for project management), process management skills (e.g. business process re-engineering), particular social-communicative skills are relevant because of the strong interaction processes as well as the specific personal skills required. The latter three methods are also the core competencies in supporting intra-organizational implementation e.g. of NPD-processes (NPD = New Product Development) that are based on the ideas and concepts in the exploration phase. Here, of course, in an industrial context the boundaries between professional and methodical competencies are fluent, since for many professional NPD processes manifold professional and methodical skills are needed (cf. Steiner, 2006).

Methodical competencies for effectiveness/efficiency orientation: An appropriate, i.e. problem-oriented use of methodical skills can eventually improve both the effectiveness of exploration as well as the efficiency of exploitation. More 'organic' methodical competencies (e.g. abstraction skills) play a greater role in exploration, whilst more 'mechanistic' methodical skills (e.g. process management competence) play a greater role in exploitation phases. Overall, we can say that methodical competencies for variety enhancement (e.g. abstraction skills, mastery of different learning techniques, multitasking, mastery of research techniques) fundamentally support processes of exploration, as they are likely to generate new expertise to the organization, as well as enabling the transition to a new technology path or business model. By contrast, methodical competencies to support experiential learning (e.g., coaching, ability to integrate opinions, modeling skills, structured thinking) rather support processes of exploitation (in the sense of decreasing variety), as incremental improvements of existing processes, products, etc. on the existing technology path or business model are reached.

Relevance of Social Competencies in Exploration and Exploitation.

Social competencies play a supporting role in all stages of the OI exploration and exploitation process, as all related transactions require social-communicative interactions. But social skills on their own do not enable either the generation of new information and solutions (cf. Kauffeld et al., 2002) or the exploitation of existing knowledge. Instead, they only support the exchange of information, serve as the mechanism to understand communication partners and should help to establish necessary social relations that underlie the exploration and exploitation process.

Social competencies for knowledge exploration: Socio-communicative processes are an integral part of knowledge acquisition, i.e. the identification of carriers and sources of knowledge, and knowledge assimilation, the implementation of routines for analyzing, processing, interpretation and understanding of information (cf. Flor et al., 2011). In the phase of identification of sources of knowledge, important roles are played by: communication skills and sociability; social networking skills to establish and maintain channels of communication into knowledge communities (cf. Hafkesbrink and Evers, 2010); trustworthiness (observance of values and principles, i.e. integrity in dealing with other people) to prepare exchange processes and negotiation situations with knowledge holders; and appreciation for the work of others. Knowledge assimilation often also occurs frequently in teams within the company. Here specific social skills (such as communication skills, presentation skills, and the ability to reach consensus) are beneficial for work groups and their specific modes of knowledge acquisition, since they facilitate the interaction and interdependence of each member significantly (cf. Jurkowski and Hänze, 2010, pp. 234-237). Finally, the handling of information uncertainty or ambiguous information (ambiguity tolerance) plays an important role in judgments as to whether such information (e.g., a trend) is important for the company or not.

Social competencies for knowledge exploitation: social and communicative skills are also a key enabling factor for the transformation and utilization of newly acquired knowledge. Within the process of knowledge transformation, a common barrier is the different language of R&D-, production- and marketing employees. Ideas, new problem solving capabilities, and new technologies are often not mediated in an intra-organizational way, as no 'common code' exists. The ability to build social relationship structures helps to transform knowledge (cf. Jansen et al., 2006). In the process of knowledge transformation employees must explicate their (tacit) knowledge. This is a process that often involves face-to-face communication, and thus is the core of social interaction ('socialization'). Therefore, the willingness and ability to transfer knowledge is required (cf. Nonaka and Takeushi, 1995). In the process of knowledge transformation and recovery, actors 'sell' their ideas often internally, partly against the resistance of risk-averse managers (cf. ter Wal and Salter, 2011) which, in addition to communicative abilities, also requires a certain degree of persuasion and enthusiasm or assertiveness.

Social competencies for outside-in and inside-out collaboration: Inbound and outbound processes not only include preparatory (e.g. planning of procurement or exploitation options) and subsequent assessment (e.g. controlling of contracts), but also various interactive stages, in which it involves the identification of and communication of technology partners or suppliers. In this domain, different media, stakeholders and communication channels such as journals, patents, websites, exhibitions, technology brokers, networks, etc. play an important role (cf. Kutvonen and Torkkeli, 2008).

In many of the related transaction processes, both explicit and implicit knowledge play an important role. Thus, in addition to essential methodical skills, social and communicative skills become relevant in outbound and inbound processes, as tacit knowledge usually is transmitted only by face-to-face communication. These include

discourse-/mediation-/negotiation abilities (e.g. for negotiation with external with external partners), ability to manage conflicts, to take criticism, to reach consensus (e.g. for the proper management of knowledge inflows and outflows in cooperative networks), ability to bring about a balance of interests (e.g. to balance exploration and exploitation networks), assertiveness (e.g. in negotiation phases), social networking skills (e.g. to support networking tasks), persuasive and inspirational abilities (e.g. in negotiation phases), trustworthiness and appreciation (e.g. to stabilize cooperative networks).

Social competencies in change management and routinization processes: Looking at change management, social skills are needed to implement a participatory approach in change processes. Here a variety of interaction and communication processes is needed to remove barriers for employees, not only to prevent them from being concerned, but also to involve them as stakeholders, so that they can jointly develop solutions for organizational and personal adjustment problems. This includes the following competencies: discourse-/mediation-/negotiation abilities (the core individual competence in organizational development processes), ability to manage conflicts, to take criticism, to reach consensus (e.g. to conduct and lead workgroups), ability to bring about a balance of interests (e.g. to conciliate interests of leadership and employees), assertiveness (e.g. to stabilize and substantiate decisions), empathy (e.g. to understand behavioral patterns of employees), ability to develop a common sense of responsibility (the core of leadership capabilities), ability to strengthen cohesion in a team (integration) (one of the core competences in OD-projects), ability to motivate (for organizational change), trustworthiness and appreciation (the basis for successful OD-projects).

Social competencies for invention and implementation: In highly exploratory processes, such as in NPD, an innovation-friendly communication culture has to be created that stimulates interaction and communication processes between the parties from the perspective of the organization. This is essential as a framework. Such dialogue cultures are often undirected, are based on ad-hoc interactions and use multiple channels and media. To support these processes, the following social competencies are relevant (in addition to the already described methodical skills): ambiguity tolerance (for dealing with ambiguous information in a team), willingness and ability to transfer knowledge (in processes of knowledge absorption), ability to manage conflicts, to take criticism, to reach consensus, ability to balance different interests (e.g. to resolve conflicts in a product development team), communication skills (to promote a culture of dialogue), cooperation and team integration skills (e.g. integration into a development team), ability to motivate (Ability to motivate team members and enthusiastic about your ideas), appreciation (for the work of team members).

As part of the implementation processes, social and communicative skills must support experiential learning experiences for the deepening of professional knowledge. The aim is, to continuously improve routine exploitation processes (e.g. production, service delivery, quality assurance, distribution, etc.) by improving team performance. For that the following social skills are required: assertiveness (an opinion in the team can enforce and ensuring social acceptance), ability to create a common sense of responsibility (important for a group result in routine processes), ability to promote integration and cohesion in a team (the core competence for team management), collegiality (to promote team cohesion), communication skills (especially in general communication), cooperation and team integration skills (ability to integrate into a team), loyalty (to promote team cohesion)

Social competencies to promote effectiveness and efficiency orientation: while in the domain of methodical skills a classification based on organic and mechanistic species is still possible, it is difficult to advance such a classification for social skills.

Many of the aforementioned social skills are likely to focus on effectiveness ("doing the right things"), and may be even beneficial to improve efficiency ("doing things right"). Social skills, in particular those to support exploratory activities (i.e. skills that are more variety enhancing), are supposed to promote effectiveness by directing social interactions towards discovery contexts, flexibility, re-orientation, learning, creativity, etc. Social skills that particularly support exploitative activities (i.e. skills that are more inclusive and narrowing) are likely to affect efficiency because they are more directed towards discipline, cohesion, security, routines, etc. and thus may be characterized as narrowing variety.

Relevance of personal competencies in exploration and exploitation.

Personal competencies reflect the personality of active players. This competence dimension is the basis for the acquisition of social-communicative, methodological and technical/professional skills. Here an unambiguous assignment of dedicated personal skills to the phases of exploration and exploitation is difficult. Therefore the following comments are rather cursory. The tendency is that: for exploration activities such personal skills are asked for that put the actor into a learning mode to capture new knowledge. For exploitation activities, such personal skills are conducive to support the application of knowledge in the context of a known issue.

Studies on the competence of innovation staff in **knowledge exploration and invention** (cf. Kaltenegger, 2008) highlight the following personal skills:

- Creativity, initiative, commitment, curiosity, flexibility, frustration tolerance, value orientation, spontaneity, and discipline in the implementation (ibid, p. 109),
- Self-reflection, openness to experience (e.g. active imagination, independent thinking, curiosity) (cf. Barrick and Mount, 1991; Costa and McCrae, 1992),
- Aesthetic appreciation, varied interests, appeal through complexity, high energy, independent judgment, autonomy, intuition, self-confidence, conflict resolution, etc. (cf. Barron and Harrington, 1981; Comacchio and Bonesso, 2011, p. 5).

During phases of **knowledge exploitation and implementation**, the share of creativity, personality, and variety enhancing personal competencies may be lower, since such personal competences are in demand that focus on routines, such as *authority, assertiveness/persistence/persistence, patience, strength of character (advocacy of beliefs), ambition, accuracy, punctuality, diligence, execution, and reliability*.

In **inbound and outbound processes,** besides *comprehension* and *creativity* (as for the evaluation of technology potentials), – personal competencies – such as *authority, assertive/confident demeanor, entrepreneurial thinking and action* – are required to support negotiation situations.

In **change management processes** personal skills are required such as *stress resistance* (to cope for the initial shock of change), *frustration tolerance* (for dealing with spontaneous rejection), *comprehension to promote rational insight* (to internalize and integrate the new knowledge (knowledge), *openness and emotional stability* (for acceptance of change), and willingness for training (to adapt to changing situations). When routinization and institutionalization of the changes are carried out, other personal competencies to narrow variety play an important role, e.g. *authority, assertiveness/persistence/persistence, patience, strength of character (advocacy of beliefs), ambition, accuracy, punctuality, diligence, execution*.

Finally, **effectiveness** should turn out more likely as a result of variety enhancing and efficiency – again with variety reducing personal skills.

Résumé on Individual Competencies for Exploration and Exploitation

We can now summarize the previously described empirical findings and hypotheses. For individual competencies that support **exploration activities**, attributes are needed that are directed at:

- combining and expanding knowledge (professional skills),
- coping with complexity in the context of variety enhancement (methodical skills),
- cooperation in the framework of interaction relationships (social skills)
- self-reflection in a personal action routines (personal skills).

For individual competencies that shall support **exploitation activities**, attributes should focus on

- knowledge concentration (professional skills),
- simplification and variety narrowing (methodical skills),
- hierarchy for control of work processes (social skills) and
- authority in the implementation of personal action (personal skills).

Innovation actors must deal regularly with the inherent tensions between these properties, especially in OI processes. The question is, if ambidextrous skills are available that resolve these tensions, or at least pair together those complementary skills which are able to reduce the tensions and make them manageable.

We can now introduce the following arguments for individual exploration and exploitation, as well as for individual ambidextrous competencies:

Individual Exploration Competencies

- In exploration phases it is indispensable to add new professional knowledge to existing knowledge. The more professional knowledge exists within the firm, the more opportunities for combining old and new knowledge are available (cf. Ericsson, 2007). In combining knowledge domains new competencies emerge that represent converging technology domains etc. (cf. Hafkesbrink and Schroll, 2010). Consequently, if a technology path will be changed, existing knowledge may become obsolete, and it has to be unlearned (cf. Cegarra-Navarro et al., 2011; Mäkitalo-Keinonen and Arenius, 2010; Cepeda-Carrión et al., 2009), as otherwise it may lead to a cognitive lock-in in the innovation process. "Unlearning can be understood as a context where employees can change their habits and routines and forget old knowledge, and substitute new habits and knowledge, as part of a major process or which might be described as learning" (Cepeda-Carrión et al., 2009, p. 3).
- The process of professional knowledge generation in exploration phases is supported by methodical, social and personal competences (interdisciplinary competencies) enabling the process of learning. Hence preconditions must be fulfilled so that knowledge can be identified and assimilated (e.g. by applying specific learning methods) and that implicit knowledge is shared. Thus personal competencies are essential for initiating knowledge sharing and accumulation.

Individual Exploitation Competencies

- In the case of exploitation, existing knowledge is improved incrementally, especially by experience accumulation, i.e. the application of existing knowledge within a specific work context, in the framework, for example, of a production process.

- Experience based learning takes place alongside established technology paths, i.e. on the basis of an existing production process or product.
- Methodical, social and personal competencies (interdisciplinary competencies) support improvements in experience based learning on the existing technology paths. Methodical competencies enable experience based learning with the aim of incrementally improving existing processes. Specific social competencies are needed to strengthen discipline in a team. Personal competencies, such as authority, lead to a sustainable efficiency orientation.

Individual interdisciplinary ambidextrous competencies

The question now arises, as to whether there are individual interdisciplinary competences that equally support exploration and exploitation? These may be defined as 'ambidextrous' competences. The literature review so far encourages the idea of such ambidextrous skills.

However, our thoughts on such ambidextrous individual competences go a step further, since it may be necessary to be equipped with individual ambidextrous meta-skills especially to manage the tensions or convergence processes that exist between exploration and exploitation such as:

- Ambidextrous methodical competencies need to support the emergence of professional knowledge for exploration and exploitation processes at the same time, e.g. knowledge brokerage, topsy-turvy-thinking, multi-tasking, dialectic thinking, etc.
- Ambidextrous social competencies should at the same time enable and support social integration and discipline (cf. Gibson and Birkinshaw, 2004), e.g. diplomatic and rhetorical capabilities, tolerance to ambiguity, mediation capabilities, etc.
- Ambidextrous personal competencies need to provide the ground for the development of social and methodic competences, e.g. capability to combine alternative logics, emotional ambivalence, capability to think outside the box, etc.

In addition there may exist professional ambidextrous competences – which we call **Professional Hybrid Competencies** – because they do not serve exploration and exploitation equally, but emerge as a result of technology convergence, etc. In a dynamic and converging technology environment, professional skills from multiple sources and disciplines must to be combined in one individual or must be divided amongst a team considering a specific work or task division. This depends on the lifecycle of knowledge to be integrated, on the availability of specialists in that area, on the size of the firm, and on the phase of the innovation process (cf. Hafkesbrink et al., 2013).

On this basis Professional Hybrid Competencies emerge which may be displayed as 'T-shaped Skills' (cf. Karjalainen and Salimäki, 2008; Oskam, 2009) providing the ground for establishing core competencies within the innovation process. Such T-Shaped Skills are dependent on the convergence of technologies (e.g. mechatronic engineer, video-journalist, bio-informatician etc.).

Table 2 defines selected individual ambidextrous interdisciplinary competencies and provides references from the literature.

Table 2. Examples of individual interdisciplinary ambidextrous competencies (own compilation)

Competence-Item	Commentary	Source

Dialectic thinking/trade-off- or synthesis thinking	"There is more than one truth“	Forster et al. (2003); Bledow et.al. (2009)
Emotional ambivalence	Simultaneous presence of negative and positive emotions	Fong (2006)
Knowledge brokerage	Integration and meshing up of knowledge from separate sources	Hobus and Busch (2011)
Topsy-turvy-thinking	Turn everything upside down	Gibson and Birkinshaw (2004)
Paradoxical cognition	Openness against strategic contradictions	Smith and Tushman (2005)
Strategic entrepreneurial thinking and action	Management-Competencies between emergence and planning	Lewis et al. (2002)
Capability to lead discourses, diplomatic capability	Moderation of conflicts in cross-functional teams	Lovelace et al. (2001)
Hybridization of alternative logics	Connecting multiple institutional responses as a reaction to change	Perkmann et al. (2011)
Lateral thinking	Substantial part of ambidextrous thinking (left mode of brain = rational thinking, right mode = creative thinking)	De Bono (1990); Faste (1994)
Ambiguity tolerance	Requisite variety, capability of perspective-taking and interpretive skills are factors leading to generate useful ambiguity, while analytic skills are required to reduce ambiguity	Brun (2011); Jansen et al. (2009)
Multitasking	Fulfilling multiple roles within a certain time frame	Mom et al. (2009)
Integration of opinions	Learning and achieving convergence through conversation among members	Berson et.al. (2006); Lubatkin et.al. (2006)
Rhetoric Capabilities	Applying e.g. Mission Statements to give orientation to employees for a common philosophy	McCarthy and Gordon (2011); O’Reilly and Tushmann (2004)

Based on our analysis, table 3 displays the relevant methodical, social and personal competencies along the dichotomic axes of exploration and exploitation:

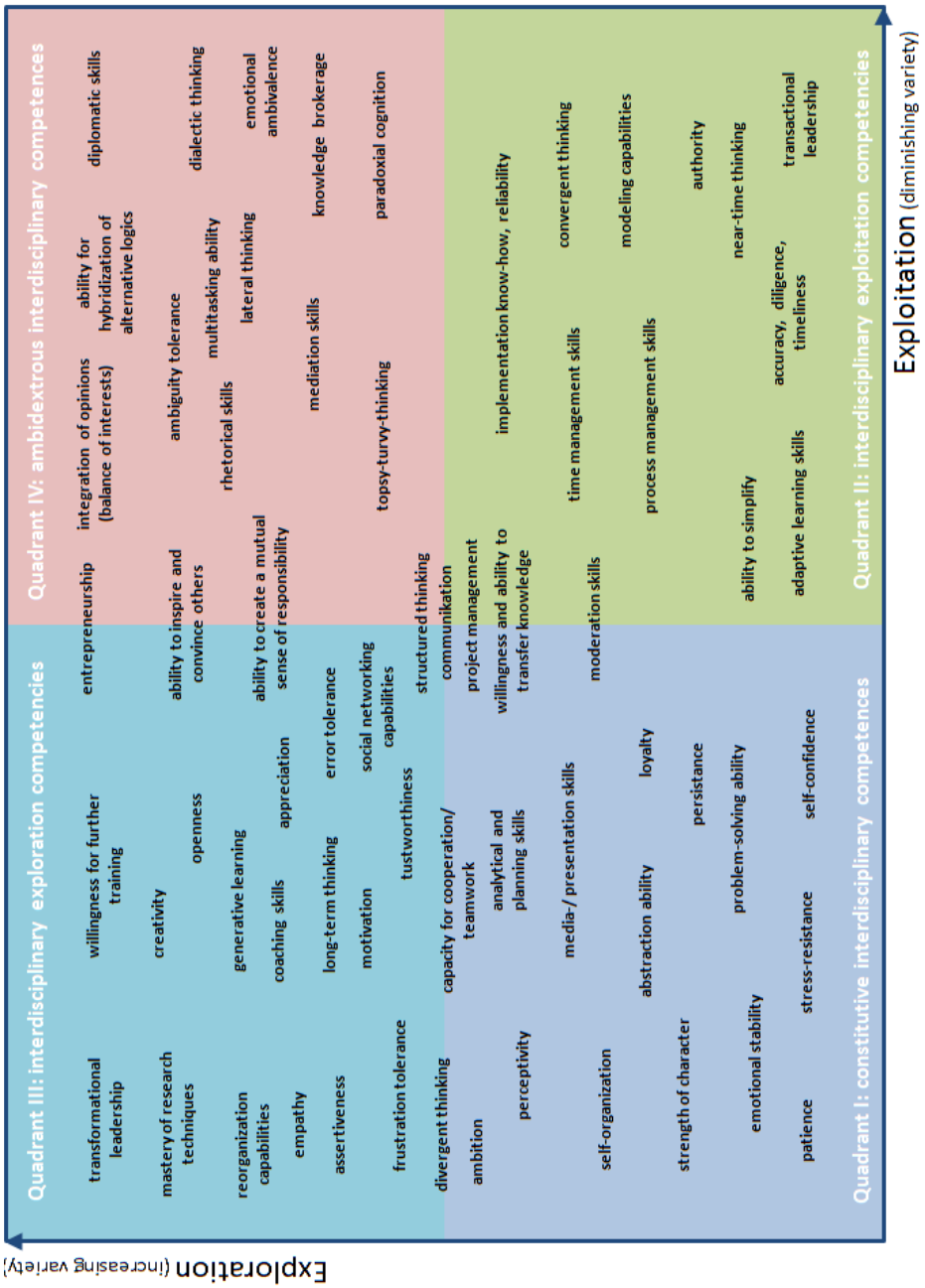
- To accomplish the day-to-day work and innovation tasks certain constitutive interdisciplinary competencies must exist, such as patience, stress-resistance, self-confidence, emotional stability, etc. These competencies provide the basic enabling levers for acquiring social and methodical competences for exploration and exploitation (Quadrant I).
- Interdisciplinary exploitation competencies (1st order competencies) serve as a lever to reduce variances with the aim of best possible exploiting existing

professional knowledge. These are e.g. process management skills, time management skills, adaptive learning skills, timeliness, diligence etc. They provide the ground for incremental improvements of existing processes and for routinizing business models (Quadrant II). Interdisciplinary exploration competencies (1st order competencies) serve as a lever to enhance variances with the aim of exploring new potentials and professional competences. These are e.g. creativity, openness, generative learning, transformational leadership, reorganization capabilities, etc. They serve as a basis for (radical) innovation processes (Quadrant III).

- Ambidextrous interdisciplinary competences (2nd order (meta-) competences) serve as a lever to solve role conflicts in balancing exploration and exploitation processes. These are e.g. dialectic (relativistic) thinking/trade-off- or synthesis thinking, emotional ambivalence, knowledge brokerage, topsy-turvy-thinking, paradoxical cognition etc. (Quadrant IV).

We assume for all individual interdisciplinary competencies that the development requirements of these competencies do not alter significantly as the size of the organization changes, but we consider – as a result of SME scarce resources – that SME managers and employees have to play more complex hybrid or ambidextrous roles in day-to-day business and in innovation as compared to large companies (cf. Hafkesbrink et al., 2013).

Table 3. Individual interdisciplinary and ambidextrous competencies (own compilation)



4. Summary and Outlook

In this paper we developed a new link between the well known OI- and a new Ambidexterity model that provides a heuristically rich access to the challenge of deriving competencies dimensions, categories and indicators to describe the complex skills needed for the entire OI process.

In our conceptual framework we presented 5 dimensions of organizational competencies, recurring on the ambidexterity view of exploration and exploitation activities in the OI process:

Dimension	Exploration	Exploitation
Knowledge management/ -absorption	Identification/ assimilation of knowledge	Transfer/ valorization of knowledge
Collaboration with external partners	Outside-In collaboration capability	Inside-Out collaboration capability
Stability/ organizational learning	Dynamic adaptability	Routinization
Innovation process	Inventive capability	Imitation/ replication capability
Performance	Effectiveness	Efficiency

Fig. 8. Organizational Competencies for OI derived from the Ambidexterity Model

Thus, on the organizational level, core organizational competencies should be available to balance the different tensions between exploration and exploitation of resources. We learned that specific explorative competences are needed in OI processes as opposed to normal (incremental and/or closed) innovation processes. From an intensive literature review we learned that the modes of resources exploration and exploitation, as the basic phases of any innovation process, are moderated by a specific shape of organizational antecedents (i.e. specialization, coordination, etc.) that play an important role in moderating the performance of organizational competences. We presented an OI Audit that refers to these organizational competencies and antecedents by operationalizing more in detail the particular items displayed in fig. 8.

In addition, as being a central element of the ambidexterity model, we learned about the moderating effects of individual competences on resources exploration and exploitation in the innovation process. We presented a conceptual framework to define relevant professional, methodic, social and personal competencies for OI processes following the analytical distinction between exploratory and exploitative tasks for individual innovation actors.

From the description of these individual competencies we learned that there are rather exploratory individual competencies that better fit with the challenges of exploration and rather exploitative individual competencies that better fit with the challenges of exploitation.

The material and the analytic framework presented in this paper may serve as a template for:

- comprehensive empirical studies on industry needs for competencies

development for OI by HEIs. For this purpose, it needs to be streamlined into a manageable format that does not overstress industry in a questionnaire survey;

- conducting more in-depth case studies on OI processes, as it delivers a rich heuristic basis for interviews in the firms, joint research partner organizations etc.

For both empirical tasks a specific research agenda has to be set up that also covers the second order loops between organizational antecedents, their moderating effects on individual competencies development and cumulating effects of individual and team learning bottom-up to organizational learning and to organizational competences.

Also for both empirical tasks, a differentiation between inter-organizational and intra-organizational characteristics of organizational antecedents should be considered.

Finally we pointed out that – especially for SMEs in case a task division is not appropriate due to the number of employees – there are complex challenges of contextual ambidexterity in a sense that one individual actor has to perform different roles in the innovation process that may cause conflicting demands etc. (see again table 3).

Since this is definitely virgin soil, we hope that further research will gain new insights in these relationships as they are of interest for both industry and HEIs in the area of OI and Ambidexterity.

5. Acknowledgement

The research underlying this paper was conducted under the joint R&D project, 'Balance zwischen Flexibilität und Stabilität: Integrierte Steuerungsinstrumente zur Steigerung der Innovationsfähigkeit von Unternehmen der Verlags- und Medienwirtschaft' (FLEXMEDIA; Contract number 01FH09009), sponsored by the German Ministry for Education and Research (BMBF) and the European Union (ESF). It is meant as a first contribution to an EU-funded Network on OI (542203-LLP-1-FI-ERASMUS-ENW), called OI-Net (www.oi-net.eu) where the authors are involved. Duisburg, 23.2.2014.

6. References

Abernathy, W.J. & Clark, K.B. (1985). Innovation: Mapping the Winds of creative Destruction, in: *Research Policy, 14* (1), pp. 3-22.

Akao, Y. & Mazur, G. (2003). The leading Edge in QFD: Past, Present and Future, in: *The International Journal of Quality & Reliability Management, No. 20* (1), pp. 20-35.

Andriopoulos, C. & Lewis, M. W. (2009). Exploitation-Exploration Tensions and organizational Ambidexterity: Managing Paradoxes of Innovation, in: *Organization Science, No. 20*(4), pp. 696–717.

Ansett, S. (2004). Boundary Spanner: The Gatekeeper of Innovation in Partnerships. Download: DOI=http://www.greenleaf-publishing.com/content/pdfs/af06anse.pdf.

Argyris, C. & Schon, D. (1996). *Organizational learning II: Theory, method, and practice*. Reading, MA: Addison-Wesley.

Atuahene-Gima, K. (2003). The Effects of centrifugal and centripetal Forces on

Product Development Speed and Quality: how does Problem Solving matter?, in: *Academic Management Journal 46*, pp. 359-374.

Auh, S. & Menguc, B. (2005). Balancing Exploration and Exploitation: the moderating Role of competitive Intensity, in: *Journal of Business Research 2005, No. 58*, pp. 1652-1661.

Baden-Fuller, C. & Winter, S. (2005). Strategic Renewal: How large complex Organizsations prepare for the Future, in: *International Studies of Management & Organization, 27*, pp. 150-169.

Baldwin, C./Hienerth, C. & von Hippel, E. (2006). How User Innovations become commercial Products: A theoretical Investigation and Case Study, in: *Research Policy, No. 35*, pp. 1291 - 1313.

Barrick, M. & Mount, M. (1991). The Big Five Personality Dimensions and Job Performance - A Meta-Analysis, in: *Personnel Psychology, No. 44*, pp. 1 - 26.

Barron, F. & Harrington, D. (1981). Creativity, Intelligence and Personality, in: *Annual Review of Psychology, No. 32*, pp. 439-476.

Benner, M. J. & Tushman, M. L. (2003). Exploitation, Exploration, and Process Management: The Productivity Dilemma revisited, in: *Academy of Management Review, Vol. 28, No. 2*, pp. 238-256.

Berson, Y./Nemanich, L.A./Waldman, D.A. & Keller, R.T. (2006). Leadership and organizational learning: A multiple levels perspective, in: *The Leadership Quarterly 17 (2006)*, pp. 577 – 594.

Bessant, J./von Stamm, B./Moeslein, K. & Neyer, A.-K. (2010). Backing outsiders: Selection strategies for discontinuous innovation, in: R*&D Management Journal, 40*(4), pp. 345-434.

Bledow, R./Frese, M./Anderson. N./Erez, M. & Farr, J. (2009). A Dialectic Perspective on Innovation: Conflicting Demands, Multiple Pathways, and Ambidexterity, in: *Industrial and Organizational Psychology: Perspectives on Science and Practice, No. 2*(3). Download: http://www.evidence-based-entrepreneurship.com/content/publications/391.pdf.

Boscherini, L./Cavaliere, A./Chiaroni A./Chiesa, V. & Frattini, F. (2009). The process of organizational change in Open Innovation models: evidence from a sample of high - tech firms, in: Huizingh K.R.E., Conn, S., Torkkeli, M. and Bitran, I. (Eds.) *Proceedings of the XX ISPIM Conference 2009*.

Brem, A. & Viardot, E. (2013). More OI means more Ambidexterity, in *ISPIM Magazine, Issue 2/2013*, Download: http://magazine.ispim.org/2013/04/more-open-innovation-means-more-ambidexterity/.

Brun, E. (2011). Ambiguity Management As An Underlying Process Of Contextual Ambidexterity in Innovation, Paper presented at EURAM 2011 on Management Culture in the 21st Century, EBS Tallinn.

Burns, T. & Stalker, G. M. (1961). *The Management of Innovation*. London: Tavistock.

Cegarra-Navarro, J./Sanchez-Vidal, M. & Cegarra-Leiva, D. (2011). Balancing Exploration and Exploitation of Knowledge through an unlearning context. An empirical Investigation in SMEs, in: *Management Decision, Vol. 49 No. 7,* 2011, pp. 1099-1119, available at www.emeraldinsight.com/0025-1747.htm.

Cepeda-Carrión, G./Cegarra-Navarro, J. & Jimenez-Jimenez, D. (2009). Analyzing an absorptive capacity: Unlearning context and Information System Capabilities as catalysts for innovativeness, Download http://repositorio.bib.upct.es/dspace/bitstream/10317 /16 67/1/aac.pdf.

Chesbrough, H. (2003). *Open Innovation. The new imperative for creating and profiting from technology*, Harvard Business School Press.

Chesbrough, H. (2004). Managing Open Innovation, in: *Research Technology Management, Vol. 47* (2004), Nr. 1.

Cohen, W.M. & Levinthal, D.A. (1990). Absorptive Capacity: a new Perspective on Learning and Innovation - Technology, Organizations and Innovation, in: *Administrative Science Quarterly*, March.

Collis, D. J. (1994). Research note: How valuable are organizational capabilities? In: *Strategic Management Journal 15* (Winter special issue), pp. 143-152.

Comacchio, A. & Bonesso, S. (2011). How do Firms enact Absorptive Capacity? A routine based Approach, Paper presented at the DRUID 2011 on Innovation, Strategy and Structure – Organizations, Institutions, Systems and Regions at Copenhagen Business School, Denmark, June 15-17, Download: http://druid8.sit.aau.dk/druid/acc_papers/0r104y1o jo6m8hrjs711qg8 lr0ty.pdf.

Cooper, R. & Kleinschmidt, E. (1995). Benchmarking Firms' New Product Performance and Practices, in: *IEEE Engineering Management Review, Vol. 23,* No. 3, pp. 112 – 120.

Costa Jr., P. & McCrae, R. (1992). NEO PI-R. Professional Manual. Odessa, Florida: Psychological Assessment Resources, Inc. zitiert bei Da Mota Pedrosa/Jasmand 2011.

De Bono, E. (1990). *Six Thinking Hats*. Penguin Books, London u. a.

Dimov, D. & Martin De Holan, P. (2005). Tales of Serial Exploration - Knowledge Specialization, Repetitive Momentum, Early Conditioning, and Exploratory Drives in a Universe of Organizations. Download: http://conocimiento. incae.edu/ES/centros-academicos-investigacion/pdfs/TalesOfSerialExplor ation.pdf.

Duncan, R.B. (1976). The Ambidextrous Organization. Designing Dual Structures for Innovation, in: Kilmann, R.H./Pondy, R. & Slevin, D. (Hrsg.): *The Management of Organization*, North Holland/New York, pp. 167-188.

Eisenhardt, K. M. & Martin, J. A. (2000). Dynamic Capabilities: What are they? In: *Strategic Management Journal, Vol. 21*, pp. 1105-1121.

Eisenhardt, K. & Tabrizi, B.N. (1995). Accelerating adaptive processes: Product innovation in the global computer industry, in: *Administrative Science Quarterly, Vol. 40*, pp. 84 - 110.

Ericsson, K. (2007). The Influence of Experience and deliberate Practice on the Development of superior Expert Performance, in: K.A. Ericsson (ed.): *The Cambridge Handbook of Expertise and Expert Performance* (5th edition), Cambridge.

Erpenbeck, J. & Von Rosenstiel, L. (Ed.) (2003). *Handbuch Kompetenzmessung. Erkennen, Verstehen und Bewerten von Kompetenzen in der betrieblichen, pädagogischen und psychologischen Praxis*. Stuttgart: Schäffer-Poeschel.

Erpenbeck, J. & Von Rosenstiel, L. (2003): „Einführung". In: Erpenbeck, J.; Von Rosenstiel, L. (Ed.) (2003): *Handbuch Kompetenzmessung. Erkennen, Verstehen und Bewerten von Kompetenzen in der betrieblichen, pädagogischen und psychologischen Praxis*. Stuttgart: Schäffer-Poeschel. S. XI –XX.

Escher, J.-P. (2005). *Technology Marketing in Technology-based Enterprises – The Process and Organization Structure of external Technology Deployment*, Dissertation, No. 15886, Eidgenössische Technische Hochschule, Zürich, Schweiz.

Evers, J. & Hafkesbrink, J. (2010). Innovation 3.0: Embedding into Community Knowledge – The Relevance of Trust as Enabling Factor for Collaborative Organizational Learning, in: Hafkesbrink, J./Hoppe, H.-U. & Schlichter, J. (Eds.), *Competences Management for Open Innovation. Tools and IT- support to unlock the innovation potential beyond company boundaries*, Lohmar, pp. 205 - 236.

Faste, R. (1994). Ambidextrous Thinking, in: Innovations in Mechanical Engineering Curricula fort he 1990s, American Society of Meechanical Engineers, New York, November 1994, Download: http://www.fastefoundation.org/publications/ambidextrous_thinking.pdf.

Flor, M./Oltra, M. & Garcia, C. (2011). Technological Opportunities, absorptive Capacity and Firm's Innovation, *The Proceedings of the XXII ISPIM Conference*, Hamburg, Germany, 12-15 Juni 2011.

Fong, C. T. (2006). The effects of emotional ambivalence on creativity, in: *Academy of Management Journal, 49*(5), pp. 1016-1030.

Forster, J./Higgins, E.T. & Taylor-Bianco, A. (2003). Speed/accuracy decisions in task performance: Built-in trade-off or separate strategic concerns? In: *Organizational Behavior and Human Decision Processes, 90*, pp. 148-164.

Gassmann, O. & Enkel, E. (2004). Towards a Theory of OI: Three core Process Archetypes, *Proceedings of the R&D Management Conference (RADMA)*, Lisbon, Portugal, July 6-9, 2004.

Gibson, C.B. & Birkinshaw, J. (2004). The Antecedents, Consequences, and Mediating Role of Organizational Ambidexterity, in: *Academy of Management Journal 2004, Vol. 47* (2), pp. 209-226.

Granovetter, M. (1983). The Strengths of weak Ties – A Network Theory Revisited, in: *Sociological Theory, Volume 1* (1983), pp. 201-233.

Güttel, W.H. & Konlechner, S.W. (2007). 'Dynamic Capabilities and the Ambidextrous Organization: Empirical Results from Research-intensive Firms'. http://www.synaxx.com/Referenced %2 0Material/Guttel%20-SMS-2007-Dynamic%20Capabilities%20and%20Ambidexterity.pdf.

Gupta, A.K./Smith, K.G. & Shalley, C.E. (2006). The interplay between exploration and exploitation, in: *Academy of Management Journal 49*, pp. 693-708.

Hafkesbrink, J. (1986). *Effizienz und Effektivität innovativer Unternehmungsentwicklungen - Methodische Grundlagen zur Beurteilung der Leistungswirksamkeit von Innovationen*, Diss., Duisburg.

Hafkesbrink, J. & Scholl, H. (2010). Web 2.0 Learning- A Case Study on Organizational Competences in Open Content Innovation, in: Hafkesbrink, J./Hoppe, H.-U. & Schlichter, J. (Eds.), *Competences Management for Open Innovation. Tools and IT- support to unlock the innovation potential beyond company boundaries*, Lohmar, pp. 239 - 254.

Hafkesbrink, J. & Schroll, M. (2010a). Organizational Competences for Open Innovation in Small and Medium Sized Enterprises of the Digital Economy, in: Hafkesbrink, J./Hoppe, H.-U. & Schlichter, J. (Eds.), *Competences Management for Open Innovation. Tools and IT- support to unlock the innovation potential beyond company boundaries*, Lohmar, pp. 21 - 52.

Hafkesbrink, J. & Schroll, M. (2010b). Innovation 3.0: Neue Geschäftsmodelle in der Digitalen Wirtschaft, in: *Open Innovation erfolgreich umsetzen – Unternehmensstrategien und Kompetenzmanagement*, hrsg. vom Bundesverband Digitale Wirtschaft, Düsseldorf, Universität Duisburg-Essen, Lehrstuhl für lernunterstützende und kooperative Systeme, innowise GmbH, Duisburg, ISBN

978-3-942262-17-0, S. 25-29.

Hafkesbrink, J./Bachem, C. & Kulenovic, D. (2013). Contextual Ambidexterity and Individual Competencies for Exploration and Exploitation in Small and Medium sized Enterprises, in: Hafkesbrink, J. & Shire, K. (2013). *Flexibilität und Stabilität in der Verlags- und Medienbranche – Konzepte beidhändiger Unternehmensstrategien*. Schriften zu Kooperations- und Mediensystemen. Band 34, S. 65-170. Köln 2013.

Hafkesbrink, J. & Evers, J. (2010). Innovation 3.0: Embedding into Community Knowledge – The Relevance of Trust as Enabling Factor for Collaborative Organizational Learning, in: Hafkesbrink, J./Hoppe, H.-U. & Schlichter, J. (Eds.), *Competences Management for Open Innovation. Tools and IT- support to unlock the innovation potential beyond company boundaries*, Lohmar, pp. 205 - 236.

He, Z. & Wong, P. (2004). Exploration vs. Exploitation: An empirical Test of the Ambidexterity Hypothesis, in: *Organizational Science, No. 15* (2), pp. 481-494.

Helfat, C./Finkelstein, S./Mitchell, M./Peteraf, H./Singh, D./Teece, D. & Winter, S. (2007). *Dynamic Capabilities: Understanding Strategic Change in Organizations*. Malden, MA: Blackwell.

Hess, S. & Rothaermel, F. (2008). Ambidexterity and innovative Performance: the Role of intellectual Human Capital and strategic Alliances, Working Paper, Februar 28, 2008, Download: http://www.bus.wisc.edu/insite/events /seminars/documents/Hess-Rothaermel_ Ambidexterity_02-28-08.pdf.

Hobus, B. & Busch, M.W. (2011). Organisationale Ambidextrie, in: *DBW 70* (2011), 2, pp. 189-193.

Holtmann, J. (2008). *Pfadabhängigkeit strategischer Entscheidungen. Eine Fallstudie am Beispiel des Bertelsmann Buchclubs Deutschland*. Kölner Wissenschaftsverlag.

Hsu, I. (2009). Firm Knowledge Processes and Organizational Ambidexterity, Download: http://www.commerce.nccu.edu.tw/iacmr/file/proposal/048%E8% A8%B1% E5%A3%B9%E5%82%91_Hsu,%20I-Chieh.pdf.

Jansen, J./van den Bosch, F. & Volberda, H. (2006). Exploratory Innovation, Exploitative Innovation, and Performance: Effects of Organizational Antecedents and Environmental Moderators, in: *Management Science, Vol. 52,* No. 11, November 2006, pp. 1661–1674.

Jansen, J./Vera, D. & Crossan, M. (2009). Strategic leadership for exploration and exploitation: The moderating role of environmental dynamism, in: *The Leadership Quarterly 20* (2009), pp. 5–18.

Jaworski B. J. & Kohli A. K. (1993). Market orientation: Antecedents and consequences, in: *Journal of Marketing, Vol. 57*, No. 3, pp. 53-71.

Jurkowski, S. & Hänze, M. (2010). Soziale Kompetenzen und kooperative Gruppenarbeit, in: *Psychologie in Erziehung und Unterricht, 57*, pp. 223-238.

Kaltenegger, J. (2008). *Selbstgesteuertes Lernen und Produktinnovation. Bedingungen für permanente Kompetenzentwicklung im Innovationsbereich*, Dissertation, Berlin 2008.

Kaluza, B. & Blecker, Th. (Hrsg.) (2005). *Erfolgsfaktor Flexibilität. Strategien und Konzepte für wandlungsfähige Unternehmen*, Erich Schmidt Verlag, Berlin.

Karjalainen, T. & Salimäki, M. (2008). Do offerings meet expectations? Educating T-shaped professionals in strategic design management, Paper submitted to the International DMI Education Conference, 14-15 April 2008, ESSEC Business School, Cergy-Pointoise, France, Download: http://www.dmi.org/dmi/

html/conference/academic08/papers/Karjalainen/DMI% 202008 %20TMK &MS%20Final.pdf.

Kauffeld/S./Frieling, E. & Grote, S. (2002), Soziale, personale, methodische oder fachliche: Welche Kompetenzen zählen bei der Bewältigung von Optimierungsaufgaben in betrieblichen Gruppen? in: *Zeitschrift für Psychologie, Volume 210*, No. 4, pp. 197-208.

Kaupilla, O. (2010). Creating ambidexterity by integrating and balancing structurally separate interorganizational partnerships, in: *Strategic Organization, November 2010*, No. 8, pp. 283-312.

King, N./Anderson, N. & West, M. A. (1992). Organizational innovation: a case study of perceptions and processes, in: *Work and Stress, 5*, pp. 331–339.

Klose, G. (2008). *Die Absorptionskapazität extern generierten Wissens und Technologie von Unternehmen. Ein Modell des Einflusses räumlicher Nähe auf die Absorptionskapazität*, Diss., Göttingen, Download://d-nb.info/997942576/34.

Kogut, B. & Zander, U. (1992). Knowledge of the Firm, Combinative Capabilities, and the Replication of Technology, in: *Organization Science, Vol. 3*, pp. 383-397.

Konlechner, S. & Güttel, W. (2010). Die Evolution von Replikationsstrategien im Spannungsfeld von Exploration und Exploitation, in: Stephan & Kerber 2010, pp. 27-56.

Kutvonen, A. (2009). Strategic Application of Outbound Open Innovation, *ISPIM 2nd Innovation Symposium New York City*, 6.-9.12.2009

Kutvonen, A. & Torkkeli, M. (2008). External Exploitation of Technology: a Literature Review on Pre-commercialization Activities, *Proceedings of the 1st ISPIM Innovation Symposium, Singapore*, 14-17 December 2008.

Lane, P. & Lubatkin, M. (1998). Relative absorptive Capacity and inter-organizational Learning, in: *Strategic Management Journal, No. 19*, pp. 461-477.

Lawrence, P. & Lorsch, J. (1967). Differentiation and Integration in Complex Organizations, in: *Administrative Science Quarterly 12*, pp. 1-30.

Lazzarotti, V. & Manzin, R. (2009). Different Modes of Open Innovation: a theoretical Framework and a empirical Study, in: *Proceedings of The XX ISPIM Conference Huizingh K.R.E., Conn S., Torkkeli M. & Bitran I. (Eds.): Proceedings of The R&D Management Conference 2009* Butler, J. (Ed.) Vienna, Austria, 21-24 June 2009.

Leonard-Barton, D. (1992). Core Capabilities and core Rigidities: A Paradox in managing new Product Development, in: *Strategic Management Journal, 13*, pp. 111-125.

Levinthal, D. & March, J. (1993). Myopia of Learning, in: *Strategic Management Journal, 14*, pp. 95-112.

Lewin, K. (1948). *Resolving social conflicts: selected papers on group dynamics*. A publication of the Research Center for Group Dynamics, University of Michigan.

Lewis, M. W./Welsh, M. A./Dehler, G. E. & Green, S. G. (2002). Product development tensions: Exploring contrasting styles of product management. *Academy of Management Journal, 45*, pp. 546-564.

Lichtenthaler, U. (2007). Externally Commercializing Technology Assets: an examination of different Process Stages, in: *Journal of Business Venturing, Vol.*

23, pp. 445-464.

Lichtenthaler, U. (2008). Integrated roadmaps for Open Innovation, in: *Research-Technology Management 51*(3): pp. 45-49.

Lovelace, K./Shapiro, D. L. & Weingart, L.R. (2001). Maximizing cross-functional new product teams' innovativeness and constraint adherence: A conflict communications perspective, in: *Academy of Management Journal, 44* (4), pp. 779-793.

Lubatkin, M.H./Simsek, Z./Ling, Y. & Veiga, J.F. (2006). Ambidexterity and Performance in Small- to medium-sized firms: the pivotal Role of Top Management Team behavioral Integration, in: *Journal of Management, No. 32*, 2006, pp. 646-672.

Mäkitalo-Keinonen, T. & Arenius, P. (2010). Corporate internal resource reconfigurations, potential absorptive capacity and service creation, Paper submitted to ISPIM 2010, Download: http://www.ispim.org/members/proceedings/ISPIM2010/.

March J. G. (1991). Exploration and Exploitation in Organizational Learning, in: *Organizational Science 2*, pp. 71–87.

Marino, A. (2011). The Role of Dynamic Capabilities and Organizational Variety in Boosting Adaptation Performance, Paper presented at the DRUID 2011 on Innovation, Strategy and Structure – Organizations, Institutions, Systems and Regions at Copenhagen Business School, Denmark, June 15-17.

McCarthy, I. & Gordon, B. (2011). Achieving contextual Ambidexterity in R&D Organizations: a Management Control System Approach, in: *R&D Management 41*, 3, 2011, pp. 240-258.

McFadyen, M.A. & Cannella, A. (2004). Social Capital and Knowledge Creation: Diminishing Returns of the Number and Strength of Exchange Relationships, in: *Academy of Management Journal. 47*, 5 pp. 735-746.

Meeus, M./Faber, J. & Oerlemans, L. (2011). Co-evolution of strategy, learning and organizational structuring. Paper presented at EURAM May 9-11 Stockholm Sweden. Download: http://ecsocman.hse.ru/data/772/674/1219/co_evol_str.pdf.

Middendorf, W. (1981). *What Every Engineer Should Know about Inventing*, New York: Marcel Dekker, 1981.

Miller, D./Friesen, P.H. (1983). Strategy-making and Environment: the third Link, in: *Strategic Management Journal 1983*, No. 4, pp. 221-235.

Miron, E./Erez, M. & Naveh, E. (2004). Do personal characteristics and cultural values that promote innovation, quality, and efficiency compete or complement each other? In: *Journal of Organizational Behavior, 25*: pp. 175–199.

MIT (Hrsg.) (2004). INVENTION Enhancing inventiveness for quality of life, competitiveness, and sustainability. Report of the Committee for Study of Invention, sponsored by the Lemelson-MIT Program and the National Science Foundation. For Release April 23, 2004, Download: http://web.mit.edu/invent/n-pressreleases/downloads/report.pdf

Mom, T.J.M./Van Den Bosch, F.A.J. & Volberda, H.W. (2007). Investigating Managers' Exploration and Exploitation Activities: The Influence of Top-Down, Bottom-Up, and Horizontal Knowledge Inflows, in: *Journal of Management Studies 44*, 6 September 2007, pp. 910-931.

Mortara, L./Shawcross, J./Mills, J./Napp, J.J. & Minshall, T. (2009). Skills for OI in: Proceedings of The XX ISPIM Conference Huizingh K.R.E., Conn S., Torkkeli M. & Bitran I. (Eds.) Proceedings of The R&D Management Conference 2009 Butler, J. (Ed.) Vienna, Austria, 21-24 June 2009.

Nelson, R. & Winter, S. (1982). *An Evolutionary Theory of Economic Change*, Cambridge.

Nonaka, I. & Takeuchi, H. (1995). *The knowledge-creating company: How Japanese Companies Create the Dynamics of Innovation*. New York: Oxford University Press.

O'Reilly, C. & Tushman, M. (2004). The Ambidextrous Organization, in: *Harvard Business Review, No. 82*, pp. 74-81.

Oskam, L.F. (2009). T-shaped Engineers for interdisciplinary Innovation: an attractive Perspective for young People as well as a Must for innovative Organizsations, englische Übersetzung von Oskam, I.F., Op weg naar innovatiekracht; technisch innoveren en ondernemen als systematisch activiteit, public lecture given on 11 March 2009, Amsterdam: HvA publications(2009). Download: http://www.sefi.be/wp-content/abstracts2009/ Oskam.pdf.

Pandey, S. & Sharma, R.R.K. (2009). Organizational factors for exploration and exploitation: a conceptual review. *Global Business and Management Research: An International Journal 2009*, Vol.1, 2009, S.1-18.Download:http://www.thefreelibrary.com/Organizational+factors+for+exploration+and+exploitation%3A+a+conceptual...-a0205638236.

Perkins, D./Bess, K./Cooper, D./Jones, D./Armstead, T. & Speer, P. (2007). Community Organizational Learning: Case Studies illustrating a threedimensional model of Levels and Orders of Change, *JOURNAL OF COMMUNITY PSYCHOLOGY, Vol. 35*, No. 3, 303–328 (2007). Published online in Wiley InterScience (www.interscience.wiley.com).

Perkmann, M./Salter, A. & Tartari, V. (2011). Reaching Across Institutional Logics: Arbitrage Vs. Contamination, Paper presented at the DRUID 2011 on INNOVATION, STRATEGY, and STRUCTURE - Organizations, Institutions, Systems and Regions at Copenhagen Business School, Denmark, June 15-17, 2011, Download: http://druid8.sit.aau.dk/druid/acc_papers/q3xk6p9fdvvie3ys6lit4ogu2ldx.pdf.

Pfeffer, J. & Salancik, G. (1978). *The External Control of Organizations*, New York.

Rost, K./Hölzle, K. & Gemünden, H.-G. (2006). Promotoren oder Champions? Vor- und Nachteile der Arbeitsteilung in Innovationsprozessen, Download: http://www.wk-tim.de/fachtagungen/2006/unterlagen/Rost_Hoelzle_Gemuenden_Je_motivierter_und_spezialisierter_umso_besser_Paper.pdf.

Savitskaya, I. &Torkkeli, M. (2009). Outbound Open Innovation: A Model for External Technology Commercialization - *THE PROCEEDINGS OF THE 2ND ISPIM INNOVATION SYMPOSIUM,* NEW YORK CITY, USA - 6-9 DECEMBER 2009.

Scholz, C. (1992). Organisatorische Effektivität und Effizienz, in: Frese, E. (Hrsg.): *Handwörterbuch der Organisation*, Stuttgart (Poeschel), 3. Auflage, pp. 533-552.

Schreyögg, G. & Kliesch, M. (2002). Organisationale Kompetenzen und die Möglichkeiten ihrer Dynamisierung: Eine strategische Perspektive, *QUEM-report Schriften zur beruflichen Weiterbildung, Heft 94*, Individuelle und organisationale Kompetenzen im Rahmen des strategischen Managements, DOI=http://www.abwf.de/content/main/publik/report/2005/ report-94.pdf.

Schroll, A. (2009). Empirical Evaluation of the OI Approach: Linking Firm, Market and Leader Characteristics to OI Adoption, in: *Proceedings of The XX ISPIM Conference Huizingh K.R.E., Conn S., Torkkeli M. & Bitran I. (Eds.) Proceedings of The R&D Management Conference 2009* Butler, J. (Ed.) Vienna, Austria, 21-24 June 2009.

Schudy, C. (2010). *Contextual Ambidexterity in Organizations: Antecedents and Performance Consequences*, Diss. No. 3865, Universität St. Gallen, Difo-Druck GmbH, Bamberg 2010.

Simsek, Z. (2009). Organizational Ambidexterity: Towards a Multilevel Understanding, in: *Journal of Management Studies 46* (2009), pp. 597-624.

Smith, W. & Tushman, M. (2005). Managing strategic contradictions: A top management model for managing innovation streams, in: *Organization Science, No. 16*, pp. 522-536.

Sosik, J. J./Avolio, B. J. & Kahai, S. S. (1997). Effects of leadership style and anonymity on group potency and effectiveness in a group decision support system environment, in: *Journal of Applied Psychology, 82*, pp. 89–103.

Steiner, R. (2006). Kompetenzzellenbasierte Produktentwicklung, Dissertation, Chemitz 2006, Download: http://deposit.ddb.de/cgi-bin/dokserv?idn=982557035&dok_var=d1&dok_ ext=pdf&filename=982557035.pdf.

Steinle, A./Mijnals, P. & Muckenschnabl, S. (2009). Praxis-Guide Cross-Innovations. Wettbewerbsvorteile durch einen branchenübergreifenden Innovationsansatz, Download: http://www.zukunftsinstitut.de/verlag/studien/crossinno_inhalt_einleitung.pdf.

Stephan, M. & Kerber, W. (Hrsg.) 2010: „Ambidextrie“: Der unternehmerische Drahtseilakt zwischen Ressourcenexploration und –exploitation, *Jahrbuch Strategisches Kompetenzmanagement, Band 4*, Rainer Hampp Verlag, München.

Stevens, E. & Soparnot, R. (2007). Creating the Conditions of the Emergence of Innovative Projects: Evidence from Upstream Stages of the NPD., 18th *ISPIM Conference on Innovation for Growth: the Challenges for East & West*, 17-20 June 2007, Warsaw, Poland.

Stoetzel, M. & Wiener, M. (2013). Challenges and Dilemmas in OI: Ambidexterity as Management Approach, *Conference Proceedings of 11. Internationale Tagung Wirtschaftsinformatik, Leipzig*, 27. Februar - 01. März 2013.

Subramanian, M. & Youndt M.A. (2005). The influence of intellectual capital on the types of innovative capabilities, in: *Academy of Management Journal, 48* (3), pp. 450-463.

Szulanksi, G. & Jensen, R. (2006). Presumptive Adaptation and the Effectiveness of Knowledge Transfer, in: *Strategic Management Journal, 27*, pp. 937-957.

Teece, D.J. (1992). Competition, Cooperation, and Innovation: organizational Arrangements for Regimes of rapid technological Progress, in: *Journal of Economic Behavior and Organization, No. 18*, pp. 1-25.

Ter Wal, A. & Salter, A. (2011). Absorptive Capacity at the individual Level: an Ambidexterity Approach to external Management, Paper presented at the DRUID 2011 on Innovation, Strategy, and Structure – Organizations, Institutions, Systems and Regions, Copenhagen Business School, Denmark, June 15-17 (2011), Download: http://druid8.sit.aau.dk/acc_papers/vk3tjthho90it75jcx2ise0gcjtb.pdf

Tsai, W. (2002). Social Structure of "Coopetition" within a Multiunit Organization: Coordination, Competition, and Intraorganizational Knowledge Sharing, in: *Organization Science, Vol. 13*, No. 2, pp. 179-190.

Tushman, M. L. & O'Reilly, C. A. (1996). Ambidextrous Organizations: Managing evolutionary and revolutionary Change, in: *California Management Review, 38,* pp. 8-30.

Tushman, M./Smith, W./Wood, R./Westerman, G. & O`Reilly, C. (2002). 'Innovation Streams and Ambidextrous Organizational Designs: On Building Dynamic

Capabilities'. Retrieved April 20, 2010, from http://web.mit.edu/sloan/osg-seminar/f02_docs/TushmanEtAl_2002.pdf

Val-Jauregi, E. (2006). Fuzzy Front End of Innovation – The Effect of organizational Learning in Innovation and Business Performance, *XVII ISPIM Conference, Athens, Greece - 11-14 June 2006* ISBN 952-214-213-1., Download: http://www.ispim.org/members/proceedings/ISPIM2006/Val-Jauregi_Ester_Paper_1.pdf.

Van De Vrande, V./De Jong, J. /Vanhaverbeke, W. & De Rochemont, M. (2009). Open Innovation in SMEs: Trends, Motives and Management Challenges, in: *Technovation, 29*(6-7), pp. 423-437.

Van den Bosch, F./Volberda, H. & de Boers, M. (1999). Co-Evolution of Form absorptive Capacity and Knowledge Environment: organizational Forms and combinative Capabilities, in: *Organizational Science, No. 10*, pp. 551-568.

Vega-Jurado, J./Gutierrez-Gracia, A. & Fernandez de Lucio, I. (2008). An Analytical Model of Absorptive Capacity, Ingenio Working paper No. 2008/2, auch erschienen in: *R&D Management 38, 4*, 2008 unter dem Titel: Analyzing the determinants of firm's absorptive capacity: beyond R&D.

Wang, C.L. & Rafiq, M. (2009). Organizational Diversity and Shared Vision. Resolving the Paradox of Exploratory and Exploitative Learning, in: *European Journal of Innovation Management, 12*, pp. 86-101.

Weick, K.E. (1979). *The Social Psychology of Organizing,* 2nd Ed. Reading, M.A.: Addison-Wesley.

Winter, S. (1995). Four R's of Profitability: Rents, Resources, Routines and Replication, in: Montgomery, C. (Ed.): *Resource-based and Evolutionary Theories of the Firm: Towards an Integration*, pp. 147-178.

Xiong, J. (2011). How structural and contextual Mechanisms contribute to organizational Ambidexterity: Examine Middle Management's Role in Knowledge Inflows Management, Paper presented at the DRUID 2011 on Innovation, Strategy and Structure – Organizations, Institutions, Systems and Regions at Copenhagen Business School, Denmark, June 15-17, Download: http://druid8.sit.aau.dk/druid/acc_papers/g20b45ocbe1l29hvdrtyiroo5uxj.pdf.

Zahra, S. A. & George, G. (2002). Absorptive capacity: A review, Reconceptualization, and Extension, in: *Academy of Management Review, 27,* pp. 185–203.

Zollo, M. & Winter, S. (2002). Deliberate Learning and the Evolution of dynamic Capabilities, in: *Organization Science, No. 13*, pp. 339-351.

How innovators resolve the exploitation-exploration trade-off? Evidence from the Japanese Pharmaceutical Industry

Osamu Suzuki

Institute of Business and Accounting, Kwansei Gakuin University; 1-155 Uegahara Ichiban-cho, Nishinomiya Hyogo, 662-8501, Japan; Tel. & Fax. 81-798-54-6274

suzuki@kwansei.ac.jp

Abstract. Successful innovation calls for both exploitation of existing knowledge and exploration of new knowledge, or organizational ambidexterity, but we still know little about how organizations manage innovation by resolving the trade-off relationship between exploitation and exploration. We aim to address this research gap by examining the relationship between an organization's degree of exploitation orientation and its subsequent degree of organizational ambidexterity. We argue that organizations' exploitation orientation negatively influences subsequent achievement of organizational ambidexterity because exploitation precludes subsequent exploration. However, this trade-off relationship between prior exploitation and subsequent exploration is attenuated when organizations are characterized by problemistic search, deliberate learning, or by speciation. Accordingly, these organizations' degree of exploitation orientation more positively influences subsequent achievement of organizational ambidexterity. Our empirical analyses of 32 Japanese pharmaceutical firms' new product developments over 1991 to 2000 support the argument. Our findings show that organizations may increase their degree of organizational ambidexterity by resolving, rather than circumventing, the trade-off relationship between exploitation and exploration, thereby proposing an alternative explanation of ambidexterity antecedents.

Keywords. Innovation, knowledge management, new technology, business management, pharmaceutical industry, research and development.

1. Introduction

One of the major challenges in innovation management is to exploit existing knowledge at the same time exploring new knowledge, or to achieve organizational ambidexterity (Andriopoulos and Lewis, 2009; Birkinshaw and Gupta, 2013; Duncan, 1976; Levinthal and March, 1993; Nosella, Cantarello and Filippini, 2012; O'Reilly and Tushman, 2008; Turner, Swart and Maylor, 2013). If organizations only exploit their existing knowledge, their products and services will quickly grow obsolete (Benner and Tushman, 2002; Sørensen and Stuart, 2000), and unprofitable. On the contrary, excessive pursuit of exploration may endanger organizations' reliability and accountability (Glasmeier, 1991; Hannan and Freeman, 1984), because it often is very difficult to appropriately manage risk and uncertainty associated with exploration. Accordingly, organizational ambidexterity is an important enabler of innovation.

However, balancing exploitation and exploration is not easy, because exploitation crowds out exploration (March, 1991). Accordingly, prior research tries to uncover how organizations can circumvent such trade-off relationship between exploitation and exploration (Nosella et al., 2012; Turner et al., 2013). For example, entrepreneurial teams who explore new knowledge may be separated from the rest of the organization that exploits existing knowledge (Tushman and O'Reilly, 1996).

ISSN 2183-0606
http://www.open-jim.org

Alternatively, managers may grow unique organizational contexts that forces (as well as encourages) organizational members to simultaneously pursue exploitation and exploration vigorously (Gibson and Birkinshaw, 2004; Lubatkin, Simsek, Ling and Veiga, 2006).

These works show that organizations may skillfully reduce the likelihood that the trade-off relationship between exploitation and exploration disturbs organizations' innovation initiatives. On the other hand, the possibility that organizations may resolve (rather than circumvent) the latent antagonistic relationship between exploitation and exploration is not addressed quite effectively. In this manuscript, we aim to address this research gap by employing concepts originating from the behavioral theory of the firm (Cyert and March, 1963), organizational learning theory (Zollo and Singh, 2004; Zollo and Winter, 2002), as well as theory of technological evolution (Adner and Levinthal, 2000; Cattani, 2006; Levinthal, 1998).

More specifically, we employ concepts originally established by the related, but distinct theoretical disciplines to uncover boundary conditions under which the degree to which an organization focuses on exploitation, or exploitation orientation, is less negatively associated with subsequent degree of exploration, thereby increasing subsequent degree of organizational ambidexterity. We argue that an organization's exploitation orientation is negatively associated with subsequent increases in its degree of organizational ambidexterity. We also argue that this negative relationship is attenuated when the organization is characterized by problemistic search, deliberate learning, or by speciation. Our empirical analyses of 32 Japanese pharmaceutical firms' new product developments from 1991 to 2000 support our argument. With these findings, we show the possibility of hitherto underexplored mechanisms in which organizations increase subsequent degree of their organizational ambidexterity by resolving an inherent trade-off relationship between exploitation and exploration. Our argument employs behavioral theory of the firm, theory of organizational learning, and the theory of technological evolution to uncover a dynamic process through which organizations improve their innovation capacity.

2. Theory and Hypothesis

2.1. Exploitation orientation and organizational ambidexterity

In this manuscript, we rely on research conducted by March (1991) and a number of other scholars (Benner and Tushman, 2002; Bierly and Chakrabarti, 1996; Crossan, Lane and White, 1999; Katila and Ahuja, 2002; Puranam, Singh and Zollo, 2006; Rosenkopf and Nerkar, 2001; Sørensen and Stuart, 2000; Sidhu, Commandeur and Volberda, 2007; Wu, 2012; Zhou and Wu, 2010) to define exploitation and exploration as alternative modes of organizational learning underlying innovation initiatives. More specifically, we define exploitation as the use and refinement of existing knowledge within an organization's internal domains. The term, exploration, is used to describe the search for and pursuit of new knowledge within an organization's external domains. Accordingly, organizational ambidexterity (i.e., an organizational capability to simultaneously pursue exploitation and exploration), can be defined as an organization's learning behaviors that are based on both existing and novel knowledge (Birkinshaw and Gupta, 2013; Raisch and Birkinshaw, 2008).

One notable aspect of path-dependency (Arthur, 1988; David, 1985, 1990; Levitt and March, 1988) with respect to organizational learning concerns the trade-off relationship between exploitation and exploration. More specifically, most organizations increase their degree of exploitation at the expense of exploration. Exploitation crowds out subsequent exploration because an organization's

exploitation of existing knowledge is a more certain source of organizational competence (Levitt and March, 1988; Nelson and Winter, 1982; Teece, 1982). A behavioral perspective posits that boundedly rational managers continue to exploit their existing knowledge, thereby entrapping themselves in a local peak of their performance landscape (Levinthal, 1997; Levitt and March, 1988). Consequently, their organization avoids the exploration of new peaks because a move away from the local peak causes a temporal performance decline.

An alternative explanation based on a structural or institutional perspective suggests that stakeholders select exploitation-oriented organizations over exploration-oriented ones. From the perspective of stakeholders, the former is more reliable and accountable (Hannan and Freeman, 1984) because exploitation-oriented organizations are characterized with the increasingly tighter coupling among an organization's "choices with respect to activities, policies, and organizational structures, capabilities, and resources" (Siggelkow, 2001, p. 838). The stakeholders' influence even forces an organization to abandon seemingly attractive and promising new business opportunities because these opportunities sometimes appear to be excessively exploratory (Christensen and Bower, 1996; Glasmeier, 1991).

Therefore, we argue that organizations' exploitation orientation negatively influences subsequent achievement of organizational ambidexterity because exploitation-oriented organizations grow more exploitation-oriented as they exploit their existing knowledge. This greater increase in exploitation disturbs the balance between exploitation and exploration, and decreases the degree of organizational ambidexterity.

> *Hypothesis 1. The degree of an organization's exploitation orientation is negatively associated with its subsequent achievement of organizational ambidexterity.*

2.2. Exploitation orientation and problemistic search

The foregoing discussion assumes that organizations are risk averse (March, 1991). Consequently, they prefer exploitation to exploration because most incidents of exploitation are successful in that anticipated consequences are achieved (Abernathy, 1978; Benner and Tushman, 2003; Holland, 1975; March, 1991; McGrath, 2001). However, this may not necessarily be the case in an environment where competitive requirements change quickly. For example, in a dynamically-changing and competitive environment, knowledge that once enabled favorable performance quickly grows obsolete (Sørensen and Stuart, 2000; Stuart, 1999). As a result, exploitation-oriented organizations may not be able to achieve their performance aspirations. Organizations then initiate problemistic search (Ahuja, Lampert and Tandon, 2014; Bromiley and Washburn, 2011; Cyert and March, 1963; Gaba and Joseph, 2013; Levinthal and March, 1981; Wennberg and Holmquist, 2008) because of this type of performance shortfall.

According to the behavioral theory of the firm (Cyert and March, 1963), organizations initiate problemistic search, or "search that is stimulated by a problem (usually a rather specific one) and is directed toward finding a solution to that problem" (ibid., p.121), when they realize that existing solutions to their problems are unsatisfactory. More formally restated, organizations employ problemistic search when their performance fails to reach their aspiration level (Lant, 1992; Lant and Montgomery, 1987; Shinkle, 2012). Organizations form their aspirations in reference to their close competitors' performance (Fiegenbaum, Hart and Schendel, 1996; Ocasio, 1997), as well as in reference to their own past performance (Greve, 1998). If achieved performance continues to meet their aspiration levels, organizations will not initiate problemistic search because they are satisfied with their current solutions. On

the other hand, if achieved performance falls short of aspiration levels, the organizations discard current solutions, and search for alternative solutions to their problems.

In general, the theory of problemistic search (Cyert and March, 1963; Levinthal and March, 1981) is applied to the search for alternative solutions that include knowledge, methods, or strategy. However, organizations also search for alternative learning patterns, or alternative "search rules" (Cyert and March, 1963, p. 174) when they realize that current learning performance is unsatisfactory (Baum and Dahlin, 2007; Bingham and Davis, 2012; Sitkin, 1992). Therefore, with respect to organizations that have primarily been involved in exploitation of existing knowledge who then find their performance unsatisfactory, we argue that they must initiate problemistic search for more exploratory learning patterns. Conversely, we expect that problemistic search by exploration-oriented organizations is motivated by their need to identify exploitative learning patterns.

Therefore, we argue that when exploitation-oriented organizations initiate problemistic search, they are more likely to adjust their learning patterns to increase their degree of exploratory learning. This increase in exploratory learning patterns may help balance exploitation and exploration and increase their subsequent degree of organizational ambidexterity.

> *Hypothesis 2. The degree of an organization's exploitation orientation is more positively associated with its subsequent achievement of organizational ambidexterity when the organization is more strongly characterized by problemistic search.*

2.3 Exploitation orientation and deliberate learning

Organizations may also increase exploratory learning even before a decline in their performance occurs. As discussed above, unsatisfactory performance motivates organizations to search for alternative learning patterns because unsatisfactory performance calls organizational members' attention to limitations of their existing knowledge. Similarly, even before a performance shortfall, deliberate efforts to learn (Berghman, Matthyssens, Streukens and Vandenbempt, 2013; Heimeriks, Schijven and Gates, 2012; Muehlfeld, Sahib and Witteloostuijn, 2012; Zollo and Singh, 2004; Zollo and Winter, 2002) may help organizations recognize limitations of existing knowledge and motivate them to find new knowledge through exploratory learning.

Exploitation-oriented organizations sometimes overestimate the usefulness of existing knowledge (Henderson and Clark, 1990; Leonard-Barton, 1992), thereby inappropriately applying existing knowledge in novel contexts where new knowledge would be more appropriate (Miller, 1993). This "negative experience transfer" (Gick and Holyoak, 1987) is a consequence of "premature cognitive commitment" (Langer, 1989) to existing knowledge. It prevents organizations from expanding their scope of learning. An organization's focus on exploitation is a typical example of such satisficing learning strategy to simplify experiences and to specialize adaptive responses (Levinthal and March, 1993). Because managers' cognitive capacity is so bounded (March and Simon, 1958) organizations focus on exploitation to ignore complex aspects of their experiences and narrow their adaptive responses.

Deliberate learning is one example of exercising such bounded cognitive capacity more effectively (Zollo and Singh, 2004; Zollo and Winter, 2002). Put differently, organizations can alleviate drawbacks associated with inappropriate focus on exploitation (Heimeriks et al., 2012) with deliberate efforts to learn. The risk of misapplying existing knowledge to new tasks can only be compensated for by the implementation of a second-order observation, or observers' reflections on "potential failures and maladjustments" (Schreyögg and Kliesch-Eberl, 2007, p. 926). In

addition, "the hazards of inappropriate generalization can only be attenuated via explicit cognitive effort," or "retrospective sense-making" (Zollo and Winter, 2002, p. 348) to make inferences about the applicability of lessons learned from experience. Therefore, although perceptions of success associated with prior exploitation may hamper effective learning by stimulating dysfunctional reactions such as superstition (Zollo, 2009), the dominance of these dysfunctional reactions may be alleviated by deliberate learning (Muehlfeld et al., 2012).

Specifically, when organizations try to learn deliberately, they can more precisely understand why and how existing knowledge is useful. Accordingly, organizations may try to engage in deliberate learning by their articulation and codification of their experiential learning (Heimeriks et al., 2012; Zollo, 2009; Zollo and Singh, 2004; Zollo and Winter, 2002). For example, some organizations spend time and effort on debriefing sessions and detailed postmortem analyses so that they can deliberately learn from their experiences (Heimeriks et al., 2012; Zollo, 2009; Zollo and Singh, 2004; Zollo and Winter, 2002). By articulating individually-held tacit knowledge, organizations can facilitate *ex post* sense-making to discover the precise cause-and-effect relationship that might exist between their past actions and associated outcomes (Kale and Singh, 2007; Zollo and Winter, 2002). The codification of task-related knowledge involves critical analysis and abstraction of experiences associated with a specific activity or task (Zollo and Winter, 2002). Thus, organizational members gain "a crisper understanding of what works, or what does not work and why, in the context of managing certain tasks" (Kale and Singh, 2007, p. 985) by the process of codification. As a consequence, deliberate efforts to learn can resolve superstitious learning (Zollo, 2009) or help organizations appropriately apply prior learning across significantly heterogeneous contexts such as acquisitions (Heimeriks et al., 2012; Zollo and Singh, 2004) or alliances (Kale and Singh, 2007).

In sum, deliberate efforts to learn help organizations understand the precise cause-and-effect relationships that underlie exploitation of existing knowledge and its consequences. Consequently, organizations can avoid inappropriate applications of existing knowledge by precisely recognizing how widely they can (or cannot) apply their existing knowledge. This recognition can also motivate organizations to address the need for new knowledge, because it simultaneously serves as an "enhanced recognition of the need for more fundamental change" (Zollo and Winter, 2002, p. 342). Conversely, we expect that such influences of deliberate learning are less explicit for exploration-oriented organizations because effective articulation and codification would be difficult to the extent that the focal knowledge is diversified and heterogeneous.

Therefore, we argue that exploitation-oriented organizations are more likely to involve themselves in subsequent exploratory learning if they are characterized by deliberate efforts to learn. This increase in exploratory learning may help balance exploitation and exploration and increase their degree of organizational ambidexterity.

> *Hypothesis 3. The degree of an organization's exploitation orientation is more positively associated with its subsequent achievement of organizational ambidexterity when the organization is more strongly characterized by deliberate efforts to learn.*

2.4 Exploitation orientation and speciation

In addition to organizations' risk preference and bounded rationality, stakeholders' influence may encourage organizations to exploit existing knowledge and technologies. For example, suppliers and distributors select organizations that exploit existing knowledge and technologies because exploitation-oriented organizations are

more reliable and accountable (Hannan and Freeman, 1984). Conversely, organizations' efforts to shift to a drastically new domain of knowledge hardly win supports of their suppliers and distributors (Glasmeier, 1991). Likewise, customers prefer incrementally improved products enabled by sustaining technologies (Christensen and Bower, 1996). Even competitors mutually strengthen their existing understanding of competitive conditions (Abrahamson and Fombrun, 1994). In short, organizations exploit to satisfy their stakeholders. Put differently, exploitation-oriented organizations may switch to explore when they free themselves from existing stakeholders' influences by shifting to new competitive contexts. Therefore, we argue that exploitation as speciation (Eldredge and Gould, 1972), or the exploitation of existing knowledge across multiple distinct contexts, increases the degree of organizational ambidexterity by helping organizations prepare for subsequent exploration.

Biologists originally developed the concept of speciation to explain how species evolve. According to Eldredge and Gould (1972), species evolve by the creation of derivative species appropriate for niches peripherally isolated from the original species. In these peripherally-isolated niches, resources available for survival may differ from those available in the original niche. In addition, criteria for the selection of surviving populations may also differ. Consequently, peripherally-isolated populations that possess different characteristics from the original population will be favorably selected. As peripherally-isolated populations accumulate these different characteristics, they eventually evolve into new species.

This concept of speciation is applied to the case of technological evolution (Adner and Levinthal, 2000; Cattani, 2006; Levinthal, 1998). In this context, speciation describes the application of existing technological knowledge to new domains of application. According to Levinthal (1998), new domains of application are characterized by resource abundance and selection criteria that differ from the original application. Therefore, engineers must adjust the original technology so that they can best leverage available resources in new application domains. Adjustments to the original technology are also necessary because unique selection criteria in the new application domains must be taken into account. These adjustments entail exploration of new knowledge because they eventually transform the original technology and develop a new technological "lineage" (pp. 220-221). It is important to note that Levinthal (1998) characterizes the initial shift to new application domains as "quite minor" technological changes, or even "no change in technology," to emphasize these shifts' exploitative nature (p. 218). However, because speciation is a "separation of reproductive activity" (p. 218) that is repeated across time, speciation may "trigger a divergent evolutionary path" (p. 218), thereby forcing organizations to learn in exploratory manners.

Other scholars argue that technological knowledge is not the only type of knowledge that undergoes a process characterized as speciation. For example, operational routines or business model "templates" are only imperfectly replicated (or exploited) across multiple sites (Feldman, 2000; Feldman and Pentland, 2003; Rerup and Feldman, 2011; Winter and Szulanski, 2001; Winter, Szulanski, Ringov and Jensen, 2012) because existing knowledge is "situated" (Suchman, 1987) or "embedded" (Orlikowski, 1996) to the original context. This imperfect replication allows experimental adjustments to accommodate local requirements of distinct sets of customers, competitors, and suppliers. Some local adjustments may fail, but others may result in useful novel ideas. Consequently, exploratory learning of new knowledge occurs at the level of the entire organization (Winter and Szulanski, 2001; Winter et al., 2012). Put differently, local adjustments to routines influence even "schematic" or "ostensive" aspects of organizational routines, enabling system-wide changes (Feldman and Pentland, 2003).

In short, an act of exploration can be prepared and enabled (sometimes as an unintended consequence) by speciation, or exploitation of existing knowledge across multiple distinct contexts (Nooteboom, 2000). Speciation particularly enables subsequent exploration to the extent that the original and new contexts are distinctly different. Accordingly, we argue that the positive association between speciation and subsequent exploration is more explicit for exploitation-oriented organizations because exploitation-oriented organizations apply their existing knowledge irrespective of contextual differences. On the other hand, exploration-oriented organizations apply their existing knowledge only when contextual differences are too small to warrant their pursuit of new knowledge.

Therefore, we argue that exploitation-oriented organizations are more likely to involve themselves in subsequent exploratory learning when they exploit their existing knowledge across multiple distinct contexts. This increase in exploratory learning may help organizations balance exploitation and exploration, thereby enabling organizations to increase their degree of ambidexterity.

> *Hypothesis 4: The degree of an organization's exploitation orientation is more positively associated with its subsequent achievement of organizational ambidexterity when the organization is more strongly characterized by speciation.*

3. Methods

3.1. Sample

We tested the hypotheses with data from the Japanese pharmaceutical industry. We particularly leveraged data on their new pharmaceutical products development to operationalize our sample firms' degree of organizational ambidexterity, as well as exploitation orientation. Because the Japanese market is the second largest country market for pharmaceutical products, most global pharmaceutical firms actively compete there. Furthermore, the data on the Japanese pharmaceutical firms' new products development are appropriate for our study for following two reasons.

Firstly, upon the approval of all new ethical drugs, independent specialists determine whether each new pharmaceutical contains an NCE (new chemical entity) or not. This classification is useful for our operationalization, because an NCE-based pharmaceutical product is traditionally thought to represent exploration of new knowledge in the context of new pharmaceutical development, while a non-NCE-based pharmaceutical product is thought to represent exploitation of existing knowledge (Bierly and Chakrabarti, 1996; Cardinal, 2001; Dunlap-Hinkler, Kotabe and Mudambi, 2010; Suzuki and Methé, 2011). An NCE represents a totally new chemical entity that did not exist as an ethical pharmaceutical drug before. Therefore, finding an NCE requires a search beyond known libraries of active ingredients, while a non-NCE reuses NCEs already approved for medical use. An example of a pharmaceutical drug based on a new chemical entity is Eli Lilly's Prozac, while its descendents, such as Sarafem is an example of a non-NCE-based pharmaceutical developed from the same chemical entity called fluoxetine. Initially, fluoxetine was developed as an anti-depressant (Prozac), and later, Eli Lilly redeveloped it for a different indication of premenstrual dysphoric disorder (Sarafem) upon Prozac's patent expiration.

Secondly, rich data on sample firms' new product development activities are available. Pharmaceutical firms are required to report on their clinical trial activities to the regulatory agency, which then discloses the information to the public. Leveraging these disclosed data, we are able to objectively measure sample firms'

degree of exploitation orientation, as well as ambidexterity. A professional medical magazine, called *New Current*, has been publishing exhaustive lists of pharmaceuticals under development (or pipelines) on a quarterly basis since 1990. The list shows each pharmaceutical firm's detailed pipeline information, including the name of pipelines, targeted therapeutic indications, stages of clinical trials, and whether each pipeline contains an NCE or not.

Our database consists of 32 Japanese pharmaceutical firms who gained new pharmaceutical approvals during January 2001 to December 2010 in the Japanese market. Combined revenue of these 32 firms represents 88.0% of the total Japanese market as of 2000. We constructed a panel database on these 32 firms over 10 years (from 1991 to 2000). After removing nine observations due to missing values in at least one variable of interest, we end up with a final dataset of 311 firm-years.

3.2. Variables and analysis

In order to test our hypotheses, we constructed a measure of exploitation orientation and tested its association with sample firms' increase in their degree of ambidexterity under moderating effects of problemistic search, deliberate learning, and speciation. The use of panel data helps us control for potential sources of unobserved heterogeneity. Because our models employ some time-invariant variables, we chose the random-effects generalized least squares (GLS) model, rather than the fixed-effects model because the fixed-effects model does not allow estimation of the coefficient for time-invariant regressors. Because panel data include multiple observations per sample firm, observations for the same firm are likely to be correlated. Such a serial correlation of errors within cross-section may deflate standard errors and inflate significance levels. Although Wooldridge's test for serial correlation (Drukker, 2003; Wooldridge, 2010) did not reject a null hypothesis of no serial correlation ($p = 0.3728$), we calculated standard errors using the robust clustered estimator (Arellano, 1987; Huber, 1967; White, 1980) because it produces consistent standard errors (Froot, 1989; Williams, 2000). This estimation is also robust to heteroskedasticity, another concern associated with panel data analysis (Cameron and Trivedi, 2009). Below, we describe variables employed in our model.

Our dependent variable, ΔAmbidexterity is a measure of Yt to Yt+1 increase in sample firms' degree of organizational ambidexterity, which is operationalized by a percentage of exploitative pipelines (over total pipelines) multiplied by that of exploratory pipelines. As discussed above, we follow prior works to operationalized exploration and exploitation in the context of the pharmaceutical industry with NCE-based and non-NCE based pipelines, respectively (Bierly and Chakrabarti, 1996; Cardinal, 2001; Dunlap-Hinkler et al., 2010; Suzuki and Methé, 2011). Then we multiply them to operationalize sample firms' degree of organizational ambidexterity (Gibson and Birkinshaw, 2004; He and Wong, 2004).

Our independent variable is exploitation orientation, which is a measure of sample firms' degree of exploitation orientation, operationalized by a percentage of exploitative pipelines (over total pipelines) at Yt. We employed an instrumental variable method (Bascle, 2008; Wooldridge, 2010), because our independent variable may be an endogenous variable. Specifically, a set of instrumental variables, including interest rates, long-term orientation, asset turn, and ROA are employed to gain fitted values of exploitation orientation, which then is used to estimate our dependent variable, or ΔAmbidexterity.

Interest rates are long-term interest rates on government bonds at the time of Yt. We expect interest rates are negatively associated with exploitation orientation, because higher interests rates, or higher costs of capital encourage firms to pursue more risky investment initiatives. Firms may also be less exploitation-oriented to the extent that

they are characterized with long-term orientation, which is operationalized by their share of pipelines at a phase 1 of clinical trials or before (over total pipelines) at Yt. Furthermore, it is possible that firms are more exploitation-oriented to the extent that their resources are tied to tangible manufacturing facilities (Abernathy, 1978). Therefore, we employed asset turn as a (reverse) measure of each sample firm's degree of tangible assets intensity. Finally, because sample firms' profitability may also influence their degree of exploitation orientation, each firm's return on assets (ROA) at Yt is also included. Weak identification tests by Cragg-Donald Wald F statistic (Cragg and Donald, 1993) reveal that we can reject the null hypothesis that our instruments are weak, or only marginally relevant. Tests of overidentifying restrictions by Hansen J statistic (Hansen, 1982) indicate that the null hypothesis that all instruments are valid is not rejected (p=0.1295). Furthermore, n times the R2 from the first stage of two-stage least squares (311 * 0.14) is much larger than the number of instruments (four), indicating that two-stage least squares tends to be less biased than ordinary least squares for our model (Murray, 2006).

Problemistic search is our first moderator variable. It is a measure of the degree of performance shortfall, operationalized by sample firms' social attainment discrepancy or historical attainment discrepancy (Greve, 1998; Lant, 1992), whichever is greater. We measured social attainment discrepancy with the difference between the Japanese market growth and sample firms' revenue growth from Yt-1 to Yt. As for historical attainment discrepancy, we divided sample firms' average revenue over Yt-3 to Yt-1 with current revenue at Yt. Because some authors indicate that the relationship between attainment discrepancy and the degree of subsequent search behaviors may not be linear (Audia and Greve, 2006; Baum and Dahlin, 2007; Miller and Chen, 2004; Osborn and Jackson, 1988; Staw, Sandelands and Dutton, 1981), we tested a concave relationship and a convex relationship in addition to a linear relationship and confirmed that there were no significant changes in the econometric results obtained. Below, we report the concave version that shows the highest fit.

Our second moderator variable is deliberate learning, a measure of the extent to which sample firms articulate and codify their learning from their new product developments. One of the most typical ways with which pharmaceutical firms articulate and codify their knowledge is patenting. Accordingly, we operationalized sample firms' degree of deliberate learning with their annual count of applied U.S. patents (divided by research and development expenditure to control for firm size differences) at Yt.

Thirdly, we also employed a measure of the extent to which sample firms involve themselves in speciation. Scholars operationalize product market segments (or underlying technological areas) in the pharmaceutical industry with therapeutic areas (Hoang and Rothaermel, 2010; Macher and Boerner, 2006; Nerkar and Roberts, 2004). Across therapeutic areas, there are substantial differences in terms of product development approaches, physicians' needs, and market size for pharmaceutical products (ibid.). Therefore we operationalized speciation by a percentage of pipelines launched in therapeutic areas where they had no pipelines in a preceding year (over total pipelines), at Yt.

We also employed several control variables. ΔOrganizational size is our sample firms' Yt to Yt+1 increase in their number of employees. R&D intensity is also employed as a measure of the degree of sample firms' absorptive capacity operationalized by their research and development (R&D) expenditure divided by their revenue. We also included sample firms' age to control for effects of sample firms' senescence. A dummy variable that indicates whether sample firms experienced mergers and acquisitions in Yt (M&As) controls for influences of drastic changes in their pipelines. We also employed a measure of competitive intensity observed in sample firms' niches, operationalized by the increase in patent applicants

to the United States Patent and Trademark Office's 3-digit technological classes to which sample firms filed patents. Finally, sample firms' time-invariant characteristics are controlled for by dummy-coding the variable as 1 when sample firms are diversified chemical firms and 0 otherwise.

4. Results

Table 1 shows descriptive statistics and a correlation matrix for all the variables employed in our models. Overall, the independent, moderator, and control variables show considerable variability, and most correlations among the variables range from small to moderate. We also checked the VIF (variance inflation factors) for all variables and none of them exceeds 10.0, which is the rule of thumb threshold of potential multicollinearity (Cohen, Cohen, West and Aiken, 2003).

Table 1. Descriptive Statistics and Correlations

	Mean	s.d.	1	2	3	4	5	6	7	8	9	10	11	12	13	14
1. ⊿Ambidexterity	0.39	4.73														
2. Interest rates	3.42	1.54	.13 *													
3. Long-term orientation	0.27	0.15	-.06	-.11												
4. Asset turn	0.76	0.23	.03	.01	.08											
5. ROA	8.12	4.75	.02	.16 *	-.17 *	-.10										
6. ⊿Organizational size	1.04	0.14	.04	-.10	.08	.07	.06									
7. R&D intensity	8.67	4.62	-.01	-.03	.01	-.49 *	-.02	-.06								
8. Age	93.74	65.66	.07	.00	-.18 *	-.20 *	.21 *	-.06	-.17 *							
9. M&As	0.00	0.06	.01	-.04	-.01	.03	.01	.13 *	.01	-.03						
10. Competitive intensity	1.07	0.08	.02	.17 *	-.10	.01	.04	-.07	.03	.01	.05					
11. Diversified	0.27	0.45	.02	-.04	.19 *	.43 *	-.22 *	.11	-.65 *	-.24 *	-.03	-.11				
12. Problemistic search[a]	2.65	1.09	-.13 *	.04	.10	-.10	-.15 *	-.01	.15 *	-.03	-.01	-.02	-.02			
13. Deliberate learning[a]	0.16	0.26	-.05	.02	.21 *	.13 *	-.18 *	-.03	-.44 *	-.03	-.01	-.01	.45 *	.04		
13. Speciation[a]	0.06	0.09	-.08	.04	.02	.09	-.09	.08	-.08	-.03	.00	-.01	.14 *	.15 *	.03	
15. Exploitation orientation[a]	0.30	0.07	-.16 *	-.52 *	-.26 *	-.57 *	.20 *	.08	.09	-.04	.02	-.06	-.11	.28 *	.02	.06

*a mean-centered for calculating correlations; * p <0.05*

Table 2 reports the results of our tests of hypotheses. Model 1 shows the first stage model, where we regress instrumental and exogenous variables against our independent variable. All instrumental variables show strong association with exploitation orientation. We used fitted values of exploitation orientation to estimate its association with our dependent variable (ΔAmbidexterity) in models 2a to 2f.

As model 2c shows, the coefficient for our independent variable is negative and significant ($p < .05$ or smaller), supporting hypothesis 1. We also find a support for our second hypothesis in model 2d, that shows a positive and significant ($p < .05$) coefficient for the interaction term between exploitation orientation and problemistic search. Because the slope of the regression of ΔAmbidexterity on exploitation orientation on a single value of our moderators, or α_{xit} is given by

$$\alpha_{xit} = \alpha_{main} + \alpha_{int} * \beta$$

where α_{main} is main effect's coefficient, α_{int} is interaction term's coefficient, and β is the value of the moderator, the positive α_{int} indicates that *exploitation orientation* is more positively associated with *⊿ambidexterity* as our moderator increases (Aiken and West, 1991). Likewise, model 2e shows a positive and significant ($p < .05$) coefficient for the interaction term between *exploitation orientation* and *deliberate learning*, lending a support for our third hypothesis. Finally, our fourth hypothesis is also supported by a positive and significant ($p < .001$) coefficient for the interaction term between *exploitation orientation* and *speciation* in model 2f.

Table 2. Results of the 2SLS GLS random effects instrumental variables regression analysis for the effects of exploitation orientation on increases in organizational ambidexterity

	Model 1		Model 2a		Model 2b		Model 2c		Model 2d		Model 2e		Model 2f	
Interest rates	-0.03 ***	[0.01]												
Long-term orientation	-0.14 *	[0.06]												
Asset turn	-0.22 *	[0.10]												
ROA	0.00 †	[0.00]												
⊿Organizational size	0.02	[0.04]	1.22	[1.50]	1.22	[1.51]	1.57	[1.42]	1.50	[1.47]	1.65	[1.49]	1.34	[1.61]
R&D intensity	-0.01	[0.01]	0.06	[0.07]	0.09	[0.06]	0.08	[0.07]	0.11 †	[0.07]	0.07	[0.07]	0.09	[0.06]
Age	0.00	[0.00]	0.01 *	[0.00]	0.01 *	[0.00]	0.01 †	[0.00]	0.01 *	[0.00]	0.01 †	[0.00]	0.01 *	[0.00]
M&As	0.00	[0.02]	0.79	[0.55]	0.76	[0.56]	0.85	[0.58]	0.78	[0.60]	0.84	[0.61]	1.01	[0.66]
Competitive intensity	0.02	[0.08]	1.47	[2.92]	1.55	[2.96]	0.97	[2.97]	1.61	[3.08]	0.87	[2.97]	0.26	[3.18]
Diversified	-0.02	[0.07]	0.86	[0.64]	1.40 *	[0.61]	1.08 †	[0.60]	1.46 **	[0.53]	1.13 †	[0.59]	1.24 *	[0.60]
Problemistic search[b]	0.02 ***	[0.00]			-0.56 ***	[0.13]	-0.40 **	[0.14]	-1.74 **	[0.64]	-0.42 **	[0.14]	-0.81 ***	[0.17]
Deliberate learning[b]	0.02	[0.02]			-1.07	[1.13]	-0.90	[1.35]	-0.86	[1.34]	-1.50	[1.16]	-0.85	[1.32]
Speciation[b]	0.08	[0.07]			-3.72	[2.50]	-3.51	[2.51]	-3.94 †	[2.38]	-3.51	[2.53]	-6.18 *	[2.73]
Exploitation orientation[b] (H1)							-8.88 *	[3.85]	-8.07 *	[3.80]	-9.00 *	[4.01]	-8.90 **	[3.33]
Exploitation orientation[b] X Problemistic search[b] (H2)									4.90 *	[2.08]				
Exploitation orientation[b] X Deliberate learning[b] (H3)											15.53 *	[7.86]		
Exploitation orientation[b] X Speciation[b] (H4)													107.30 ***	[29.75]
Constant	0.62 ***	[0.18]	-3.92	[4.26]	-4.41	[4.21]	-3.88	[4.17]	-5.15	[4.32]	-3.81	[4.12]	-3.20	[4.46]
N firm-years	311		311		311		311		311		311		311	
N Firms	32		32		32		32		32		32		32	
R-squared (within)	0.22		0.00		0.02		0.04		0.05		0.04		0.06	
R-squared (between)	0.12		0.14		0.35		0.23		0.29		0.23		0.30	
R-squared (overall)	0.14		0.01		0.04		0.05		0.06		0.05		0.07	

Note: Dependent variable for Model 1 is exploitation orientation, while that for Model 2a to Model 2f is ⊿ambidexterity.
a. Robust standard errors adjusted for clustering by firm are in parentheses. Two-tailed tests for all effects.
b. Mean centered.
† $p < 0.1$, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

As for control variables, we observe that older and diversified firms grow more ambidextrous. The rest of the control variables do not show statistically significant coefficients.

5. Robustness Tests

We conducted two post hoc analyses in order to further verify our research findings. Firstly, we tested the relationship between sample firms' exploitation orientation and subsequent increase in their degree of organizational ambidexterity with the continuous-updating estimator (CUE), which is more robust to heteroskedasticity and autocorrelation (Bascle, 2008; Hansen, Heaton and Yaron, 1996). The results show that all hypothesized effects are supported by statistically significant coefficients (table 3). We also tested the hypothesized relationships with a larger sample (46 firms, 446 firm-years) that also includes pipelines developed in Japan by pharmaceutical firms headquartered outside Japan. The results are fully consistent with the original findings. Overall, our post hoc analyses indicate that the previously reported findings are robust.

Table 3. Results of the CUE (continuous-updating estimator) regression analysis for the effects of exploitation orientation on increases in organizational ambidexterity

	Model 3a		Model 3b		Model 3c		Model 3d		Model 3e		Model 3f	
⊿Organizational size	0.78	[1.80]	0.89	[1.77]	1.25	[1.66]	1.38	[1.69]	0.92	[1.71]	0.47	[1.98]
R&D intensity	0.06	[0.27]	0.14	[0.29]	0.25	[0.22]	0.38 †	[0.22]	0.26	[0.22]	0.35	[0.25]
Age	0.03 *	[0.01]	0.03 †	[0.01]	0.01	[0.01]	0.01	[0.01]	0.01	[0.01]	0.01	[0.01]
M&As	-1.03	[0.71]	-0.96	[0.78]	0.63	[1.24]	0.78	[1.19]	0.92	[1.20]	1.81	[1.36]
Competitive intensity	1.71	[3.14]	1.85	[3.22]	1.04	[3.18]	2.25	[3.22]	1.06	[3.22]	0.29	[3.44]
Problemistic search[b]			-0.45 **	[0.15]	-0.16	[0.21]	-1.00 *	[0.46]	-0.13	[0.20]	-0.31	[0.25]
Deliberate learning[b]			-1.42	[2.45]	-0.94	[2.00]	-0.78	[2.07]	-3.84	[2.51]	-0.32	[2.27]
Speciation[b]			-4.00	[2.93]	-3.18	[2.90]	-3.80	[2.88]	-2.65	[2.92]	-10.12 †	[5.88]
Exploitation orientation[b] (H1)					-17.28 ***	[4.60]	-15.80 ***	[4.71]	-18.72 ***	[4.79]	-16.60 ***	[4.96]
Exploitation orientation[b] X Problemistic search[b] (H2)							6.24 *	[2.67]				
Exploitation orientation[b] X Deliberate learning[b] (H3)									23.61 *	[9.35]		
Exploitation orientation[b] X Speciation[b] (H4)											96.55 *	[45.65]
Constant	-5.18	[5.06]	-6.27	[5.25]								
N firm-years	311		311		311		311		311		311	
N Firms	32		32		32		32		32		32	
Log-likelihood	-915.68		-912.75		-871.88		-872.61		-870.76		-890.72	

a. Robust standard errors adjusted for clustering by firm are in parentheses. Two-tailed tests for all effects.
b. Mean centered.
† $p < 0.1$, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

6. Discussion and Conclusions

We aimed to uncover boundary conditions under which organizations may resolve the exploitation-exploration trade-off to achieve higher organizational ambidexterity, which is one of the most important enablers of innovation. Our empirical analysis of the pharmaceutical industry supports our argument by showing that a negative association between organizations' exploitation orientation and subsequent increases in organizational ambidexterity is attenuated by problemistic search, deliberate learning, and by speciation. Overall, we contribute to the theory of innovation, and to the theory of organizational ambidexterity in particular, by proposing that organizations may increase their degree of organizational ambidexterity by resolving the trade-off relationship between exploitation and exploration.

First, problemistic search enables exploitation-oriented organizations to increase their degree of organizational ambidexterity by encouraging a switch to the alternative organizational learning mode. In addition, exploitation-oriented organizations grow more ambidextrous when their efforts to learn deliberately allow them to recognize the limitation of exploiting existing knowledge. Finally, exploitation-oriented organizations are more likely to increase their degree of organizational ambidexterity if they exploit their existing knowledge across multiple distinct contexts. In short, the findings indicate that organizational contexts in which existing knowledge is exploited matter.

Furthermore, our findings attest the importance of a multidisciplinary perspective in the field of innovation research, because these boundary conditions are originally established by distinct scholarly disciplines, including the behavioral theory of the firm (Cyert and March, 1963), organizational learning theory (Zollo and Singh, 2004; Zollo and Winter, 2002), and the theory of technological evolution (Adner and Levinthal, 2000; Cattani, 2006; Levinthal, 1998), respectively. Our approach is justified by important roles played by behavioral dynamics, learning, as well as by technology in the process of innovation.

With these findings, we contribute to the scholarly dialogue on antecedents of organizational ambidexterity (Duncan, 1976; Gibson and Birkinshaw, 2004; Lubatkin et al., 2006; Tushman and O'Reilly, 1996 among others). In addition to antecedents identified by these prior works, we argue that organizational contexts in which existing knowledge is exploited significantly influence the extent to which organizations achieve ambidexterity. Our contribution is more than simply adding yet another set of ambidexterity antecedents. We offer an alternative and complementary explanation of ambidexterity antecedents by showing that some organizational contexts in which existing knowledge is exploited enable organizational ambidexterity in a distinctly different mechanism from alternative antecedents. Specifically, exploitation-oriented organizations characterized with problemistic search, deliberate learning, or by speciation increase their degree of ambidexterity by resolving the trader-off relationship between exploitation and exploration. On the other hand, antecedents uncovered by prior works help organizations circumvent the trader-off either by encouraging vigorous pursuit of both (Gibson and Birkinshaw, 2004; Lubatkin et al., 2006), or by physically and/or temporally separating exploitation and exploration (Duncan, 1976; Tushman and O'Reilly, 1996). In either case, the trade-off relationship is left unresolved. We owe our finding to our emphasis on examining temporal changes in organizations' degree of ambidexterity through employing a panel data analysis, that allows us to complement the prior work's cross-

sectional perspectives by offering a longitudinal perspective to understand organizations' dynamic efforts to better balance exploitation and exploration.

As for practical implications, our findings indicate several initiatives managers can take to increase their organization's degree of ambidexterity through exploitation. Firstly, it is important to maintain aggressive goals (or aspirations) so that managers are not satisfied with their performance too easily, thereby keeping their search for alternatives. Secondly, managers should encourage and recognize organizational members' efforts to articulate and codify their knowledge. Extensively supporting intra-organizational knowledge sharing may also be effective because exploiting existing knowledge across different contexts is the first step toward more active speciation.

Notwithstanding those important implications, the contributions of our study should be considered in light of its research limitations. Firstly, the usual caveat associated with the single industry study should be applied to our work. Testing the hypothesized relationships in other empirical contexts is an obvious next step. It also is important to note that we were not able to control for effects of alternative antecedents of organizational ambidexterity. Uncovering combined effects of alternative antecedents is an interesting future research agenda because there may be some interactions between alternative antecedents. As for our empirical analyses, our measure of *problemistic search* shares the same limitations with the prior work, in that the degree of attainment discrepancy is used as a proxy of problemistic search, rather than directly measuring it (Greve, 2007). We also acknowledge that our models explain rather limited portion of organizational ambidexterity's variance (as is indicated by R^2), perhaps due to the limited sample size. Finally, our findings indicate the possibility that the trade-off relationship between exploitation and exploration is resolved under some conditions, but uncovering a detailed underlying mechanism is beyond the scope of our paper. Longitudinal case study research is necessary to describe explicitly the ways in which organizations resolve, rather than circumvent, the antagonistic relationship between exploitation and exploration.

One may argue that prior degree of exploitation orientation, or the extent to which organizations are less ambidextrous, influences the magnitude of subsequent increase simply because less ambidextrous organizations should have larger improvement opportunities in their degree of ambidexterity. However, our results show more subtle relationships because we show that the manner in which organizations are less ambidextrous matters. Less ambidextrous organizations are, by definition, either over-exploratory or over-exploitative. By showing that organizations' degree of exploitation orientation is negatively associated with their subsequent degree of ambidexterity, we show over-exploratory organizations enjoy higher likelihood of increasing their degree of organizational ambidexterity, while over-exploitative organizations suffer from increasing difficulties in balancing exploitation and exploration unless some organizational contexts resolve the trade-off relationship between exploitation and exploration. Uncovering such differential influences enables us to explain dynamic processes underlying organizational ambidexterity more precisely.

7. References

Abernathy, W. J. (1978). *The Productivity Dilemma: Roadblock to Innovation in the Automobile Industry*. Baltimore, MD: Johns Hopkins University Press.

Abrahamson, E., and Fombrun, C. J. (1994). Macrocultures: Determinants and consequences. *Academy of Management Review*, 19(4), 728-740.

Adner, R., and Levinthal, D. A. (2000). Technology speciation and the path of emerging technologies. In G. S. Day, P. J. H. Schoemaker and R. E. Gunther (Eds.), *Wharton on Managing Emerging Technologies*, (pp. 57-74). Hoboken, NJ: John Wiley & Sons, Inc.

Ahuja, G., Lampert, C. M., and Tandon, V. (2014). Paradigm-Changing vs. Paradigm-Deepening Innovation: How Firm Scope Influences Firm Technological Response to Shocks. *Organization Science*, 25(3), 653-669.

Aiken, L. S., and West, S. G. (1991). *Multiple Regression: Testing and Interpreting Interactions*. Newbury, CA: Sage Publications, Inc.

Andriopoulos, C., and Lewis, M. W. (2009). Exploitation-exploration tensions and organizational ambidexterity: Managing paradoxes of innovation. *Organization Science*, 20(4), 696-717.

Arellano, M. (1987). Computing robust standard errors for within-groups estimators. *Oxford Bulletin of Economics and Statistics*, 49(4), 431-434.

Arthur, B. W. (1988). Competing technologies: An overview. In G. Dosi, C. Freeman, R. Nelson and L. Soete (Eds.), *Technical Change and Economic Theory*, (pp. 590-607). London: Pinter Publishers.

Audia, P. G., and Greve, H. R. (2006). Less likely to fail: Low performance, firm size, and factory expansion in the shipbuilding industry. *Management Science*, 52(1), 83-94.

Bascle, G. (2008). Controlling for endogeneity with instrumental variables in strategic management research. *Strategic Organization*, 6(3), 285-327.

Baum, J. A. C., and Dahlin, K. B. (2007). Aspiration performance and railroads' patterns of learning from train wrecks and crashes. *Organization Science*, 18(3), 368-385.

Benner, M. J., and Tushman, M. (2002). Process management and technological innovation: A longitudinal study of the photography and paint industries. *Administrative Science Quarterly*, 47(4), 676-706.

Benner, M. J., and Tushman, M. (2003). Exploitation, exploration, and process management: The productivity dilemma revisited. *Academy of Management Review*, 28(2), 238-256.

Berghman, L., Matthyssens, P., Streukens, S., and Vandenbempt, K. (2013). Deliberate Learning Mechanisms for Stimulating Strategic Innovation Capacity. *Long Range Planning*, 46(1–2), 39-71.

Bierly, P., and Chakrabarti, A. (1996). Generic knowledge strategies in the U.S. pharmaceutical industry. *Strategic Management Journal*, 17(Winter Special Issue), 123-135.

Bingham, C. B., and Davis, J. P. (2012). Learning sequences: Their existence, effect, and evolution. *Academy of Management Journal*, 55(3), 611-641.

Birkinshaw, J., and Gupta, K. (2013). Clarifying the Distinctive Contribution of Ambidexterity to the Field of Organization Studies. *The Academy of Management Perspectives*, 27(4), 287-298.

Bromiley, P., and Washburn, M. (2011). Cost reduction vs innovative search in R&D.

Journal of Strategy and Management, 4(3), 196-214.

Cameron, A. C., and Trivedi, P. K. (2009). *Microeconometrics Using Stata* (revised ed. ed.). College Station: Stata Press.

Cardinal, L. B. (2001). Technological innovation in the pharmaceutical industry: The use of organizational control in managing research and development. *Organization Science*, 12(1), 19-36.

Cattani, G. (2006). Technological pre-adaptation, speciation, and emergence of new technologies: How Corning invented and developed fiber optics. *Industrial and Corporate Change*, 15(2), 285-318.

Christensen, C. M., and Bower, J. L. (1996). Customer power, strategic investment, and the failure of leading firms. *Strategic Management Journal*, 17(3), 197-218.

Cohen, J., Cohen, P., West, S. G., and Aiken, L. S. (2003). *Applied Multiple Regression: Correlation Analysis for the Behavioral Sciences*. Mahwah, NJ: Lawrence Erlbaum Associates.

Cragg, J. G., and Donald, S. G. (1993). Testing identfiability and specification in instrumental variables models. *Econometric Theory*, 9222-240.

Crossan, M. M., Lane, H. W., and White, R. E. (1999). An organizational learning framework: From intuition to institution. *Academy of Management Review*, 24(3), 522-537.

Cyert, R., and March, J. G. (1963). *Behavioral Theory of the Firm*. Englewood Cliffs, NJ: Prentice Hall.

David, P. A. (1985). Clio and the economics of QWERTY. *American Economic Review: Papers and Proceedings*, 75(2), 332-337.

David, P. A. (1990). The dynamo and the computer: An historical perspective on the modern productivity paradox. *The American Economic Review (Papers and Proceedings of the Hundred and Second Annual Meeting of the American Economic Association)*: 355-361.

Drukker, D. M. (2003). Testing for serial correlation in linear panel-data models. *The Stata Journal*, 3(2), 168-177.

Duncan, R. B. (1976). The ambidextrous organization: Designing dual structures for innovation. In R. H. Kilmann, L. R. Pondy and D. Slevin (Eds.), *The Management of Organization Design: Strategies and Implementation (Vol. 1)*, (pp. 167-188). New York, NY: North Holland.

Dunlap-Hinkler, D., Kotabe, M., and Mudambi, R. (2010). A story of breakthrough versus incremental innovation: Corporate entrepreneurship in the global pharmaceutical industry. *Strategic Entrepreneurship Journal*, 4(2), 106-127.

Eldredge, N., and Gould, S. J. (1972). Punctuated equilibria: An alternative to phyletic gradualism. In T. J. Schopf (Ed.), *Models in Paleobiology*, (pp. 82-115). San Francisco, CA: Freeman, Cooper & Co.

Feldman, M. S. (2000). Organizational routines as a source of continuous change. *Organization Science*, 11(6), 611-629.

Feldman, M. S., and Pentland, B. T. (2003). Reconceptualizing organizational routines as a source of flexibility and change. *Administrative Science Quarterly*,

48(1), 94-118.

Fiegenbaum, A., Hart, S., and Schendel, D. (1996). Strategic reference point theory. *Strategic Management Journal*, 17(3), 219-235.

Froot, K. A. (1989). Consistent covariance matrix estimation with cross-sectional dependence and heteroskedasticity in financial data. *Journal of Financial & Quantitative Analysis*, 24333-355.

Gaba, V., and Joseph, J. (2013). Corporate Structure and Performance Feedback: Aspirations and Adaptation in M-Form Firms. *Organization Science*, 24(4), 1102-1119.

Gibson, C. B., and Birkinshaw, J. (2004). The antecedents, consequences, and mediating role of organizational ambidexterity. *Academy of Management Journal*, 47(2), 209-226.

Gick, M. L., and Holyoak, K. (1987). The cognitive basis of knowledge transfer. In S. M. Cormier and J. D. Hagman (Eds.), *Transfer of Learning: Contemporary Research and Applications*, (pp. 9-46). New York, NY: Academic Press.

Glasmeier, A. (1991). Technological discontinuities and flexible production networks: The case of switzerland and the world watch industry. *Research Policy*, 20(5), 469-485.

Greve, H. R. (1998). Performance, aspirations and risky organizational change. *Administrative Science Quarterly*, 43(1), 58-86.

Greve, H. R. (2007). Exploration and exploitation in product innovation. *Industrial and Corporate Change*, 16(5), 945-975.

Hannan, M. T., and Freeman, J. (1984). Structural inertia and organizational change. *American Sociological Review*, 49(2), 149-164.

Hansen, L. P. (1982). Large sample properties of generalized method of moments estimators. *Econometrica*, 50(4), 1029-1054.

Hansen, L. P., Heaton, J., and Yaron, A. (1996). Finite-sample properties of some alternative GMM estimators. *Journal of Business & Economic Statistics*, 14(3), 262-280.

He, Z.-L., and Wong, P.-K. (2004). Exploration vs. exploitation: An empirical test of the ambidexterity hypothesis. *Organization Science*, 15(4), 481-494.

Heimeriks, K. H., Schijven, M., and Gates, S. (2012). Manifestations of higher-order routines: The underlying mechanisms of deliberate learning in the context of postacquisition integration. *Academy of Management Journal*, 55(3), 703-726.

Henderson, R. M., and Clark, K. B. (1990). Architectural innovation: The reconfiguration of existing product technologies and the failure of established firms. *Administrative Science Quarterly*, 35(1), 9-30.

Hoang, H., and Rothaermel, F. T. (2010). Leveraging internal and external experience: Exploration, exploitation, and R&D project performance. *Strategic Management Journal*, 31(7), 734-758.

Holland, J. H. (1975). *Adaptation in Natural and Artificial Systems: An Introductory Analysis With Applications to Biology, Control, and Artificial Intelligence*. Ann Arbor, MI: University of Michigan Press.

Huber, P. J. (1967). The behavior of maximum likelihood estimates under non-standard conditions. *The 5th Berkeley Symposium on Mathematical Statistics and Probability*: 221-233. Berkeley: University of California Press.

Kale, P., and Singh, H. (2007). Building firm capabilities through learning: The role of the alliance learning process in alliance capability and firm-level alliance success. *Strategic Management Journal*, 28(10), 981-1000.

Katila, R., and Ahuja, G. (2002). Something old, something new: A longitudinal study of search behavior and new product introduction. *Academy of Management Journal*, 45(6), 1183-1195.

Langer, E. J. (1989). Minding matters: The consequences of mindlessness-mindfulness. In L. Berkowitz (Ed.), *Advances in Experimental Social Psychology*, (pp. 137-173). San Diego, CA: Academic Press.

Lant, T. K. (1992). Aspiration level adaptation: An empirical exploration. *Management Science*, 38(5), 623-644.

Lant, T. K., and Montgomery, D. B. (1987). Learning from strategic success and failure. *Journal of Business Research*, 15(6), 503-517.

Leonard-Barton, D. (1992). Core capabilities and core rigidities: A paradox in managing new product development. *Strategic Management Journal*, 13(Summer Special Issue), 111-125.

Levinthal, D. A. (1997). Adaptation on rugged landscapes. *Management Science*, 43(7), 934-950.

Levinthal, D. A. (1998). The slow pace of rapid technological change: Gradualism and punctuation in technological change. *Industrial and Corporate Change*, 7(2), 217-248.

Levinthal, D. A., and March, J. G. (1981). A model of adaptive organizational search. *Journal of Economic Behavior and Organization*, 2(4), 307-333.

Levinthal, D. A., and March, J. G. (1993). The myopia of learning. *Strategic Management Journal*, 14(Winter Special Issue), 95-112.

Levitt, B., and March, J. G. (1988). Organizational learning. *Annual Review of Sociology*, 14319-340.

Lubatkin, M. H., Simsek, Z., Ling, Y., and Veiga, J. F. (2006). Ambidexterity and performance in small-to medium-sized firms: The pivotal role of top management team behavioral integration. *Journal of Management*, 32(5), 646-672.

Macher, J. T., and Boerner, C. S. (2006). Experience and scale and scope economies: Trade-offs and performance in development. *Strategic Management Journal*, 27(9), 845-865.

March, J. G. (1991). Exploration and exploitation in organizational learning. *Organization Science*, 2(1), 71-87.

March, J. G., and Simon, H. A. (1958). *Organizations*. New York, NY: John Wiley & Sons, Inc.

McGrath, R. G. (2001). Exploratory learning, innovative capacity, and managerial oversight. *Academy of Management Journal*, 44(1), 118-131.

Miller, D. (1993). The architecture of simplicity. *Academy of Management Review*, 18(1), 116-138.

Miller, K. D., and Chen, W.-R. (2004). Variable organizational risk preferences: Tests of the March-Shapira model. *Academy of Management Journal*, 47(1), 105-115.

Muehlfeld, K., Sahib, P. R., and Witteloostuijn, A. v. (2012). A contextual theory of organizational learning from failures and successes: A study of acquisition completion in the global newspaper industry, 1981-2008. *Strategic Management Journal*, 33(8), 938-964.

Murray, M. P. (2006). Avoiding Invalid Instruments and Coping with Weak Instruments. *Journal of Economic Perspectives*, 20(4), 111-132.

Nelson, R. R., and Winter, S. G. (1982). *An Evolutionary Theory of Economic Change*. Cambridge, MA: Harvard University Press.

Nerkar, A., and Roberts, P. W. (2004). Technological and product-market experience and the success of new product introductions in the pharmaceutical industry. *Strategic Management Journal*, 25(8-9), 779-799.

Nooteboom, B. (2000). *Learning and Innovation in Organizations and Economies*. Oxford: Oxford University Press.

Nosella, A., Cantarello, S., and Filippini, R. (2012). The intellectual structure of organizational ambidexterity: A bibliographic investigation into the state of the art. *Strategic Organization*, 10(4), 450-465.

O'Reilly, C. A., and Tushman, M. L. (2008). Ambidexterity as a dynamic capability: Resolving the innovator's dilemma. *Research in Organizational Behavior*, 28185-206.

Ocasio, W. C. (1997). Towards an attention-based view of the firm. *Strategic Management Journal*, 18(1), 187-206.

Orlikowski, W. J. (1996). Improvising organizational transformation overtime: A situated change perspective. *Information Systems Research*, 7(1), 63-92.

Osborn, R. N., and Jackson, D. H. (1988). Leaders, riverboat gamblers, or purposeful unintended consequences in the management of complex, dangerous technologies. *Academy of Management Journal*, 31(4), 924-947.

Puranam, P., Singh, H., and Zollo, M. (2006). Organizing for innovation: Managing the coordination-autonomous dilemma in technology acquisitions. *Academy of Management Journal*, 49(2), 263-280.

Raisch, S., and Birkinshaw, J. M. (2008). Organizational ambidexterity: Antecedents, outcomes, and moderators. *Journal of Management*, 34(3), 375-409.

Rerup, C., and Feldman, M. S. (2011). Routines as a source of change in organizational schemata: The role of trial-and-error learning. *Academy of Management Journal*, 54(3), 577-610.

Rosenkopf, L., and Nerkar, A. (2001). Beyond local search: Boundary-spanning, exploration, and impact in the optical disk industry. *Strategic Management Journal*, 22(4), 287-306.

Sørensen, J. B., and Stuart, T. E. (2000). Aging, obsolescence, and organizational innovation. *Administrative Science Quarterly*, 45(1), 81-112.

Schreyögg, G., and Kliesch-Eberl, M. (2007). How dynamic can organizational capabilities be? Towards a dual-process model of capability dynamization. *Strategic Management Journal*, 28(9), 913-933.

Shinkle, G. A. (2012). Organizational aspirations, reference points, and goals: Building on the past and aiming for the future. *Journal of Management*, 38(1), 415-455.

Sidhu, J. S., Commandeur, H. R., and Volberda, H. W. (2007). The multifaceted nature of exploration and exploitation: Value of supply, demand, and spatial search for innovation. *Organization Science*, 18(1), 20-38.

Siggelkow, N. (2001). Change in the presence of fit: The rise, the fall, and the renaissance of Liz Claiborne. *Academy of Management Journal*, 44(4), 838 -857.

Sitkin, S. B. (1992). Learning through failure: The strategy of small losses. In B. M. Staw and L. L. Cummings (Eds.), *Research in Organizational Behavior*, (pp. 231–266). Greenwich, CT: JAI Press.

Staw, B. M., Sandelands, L. E., and Dutton, J. E. (1981). Threat rigidity effects in organizational behavior: A multilevel analysis. *Administrative Science Quarterly*, 26(4), 501-524.

Stuart, T. E. (1999). A structural perspective on organizational innovation. *Industrial and Corporate Change*, 8(4), 745-775.

Suchman, L. A. (1987). *Plans and Situated Actions: The Problem of Human-Machine Communication*. New York, NY: Cambridge University Press.

Suzuki, O., and Methé, D. T. (2011). Optimal ambidexterity and exploration valuableness: Balancing short-term and long-term trade-off in pharmaceutical products development. *Journal of Business Chemistry*, 8(2), 49-63.

Teece, D. J. (1982). Towards an economic theory of the multiproduct firm. *Journal of Economic Behavior and Organization*, 3(1), 39-63.

Turner, N., Swart, J., and Maylor, H. (2013). Mechanisms for Managing Ambidexterity: A Review and Research Agenda. *International Journal of Management Reviews*, 15(3), 317-332.

Tushman, M. L., and O'Reilly, C. A. (1996). Ambidextrous organizations: Managing evolutionary and revolutionary change. *California Management Review*, 38(4), 8-30.

Wennberg, K., and Holmquist, C. (2008). Problemistic search and international entrepreneurship. *European Management Journal*, 26(6), 441-454.

White, H. (1980). A heteroskedasticity-consistent covariance matrix estimator and a direct test for heteroskedasticity. *Econometrica*, 48(4), 817-838.

Williams, R. L. (2000). A note on robust variance estimation for cluster correlated data. *Biometrics*, 56645-646.

Winter, S. G., and Szulanski, G. (2001). Replication as strategy. *Organization Science*, 12(6), 730-743.

Winter, S. G., Szulanski, G., Ringov, D., and Jensen, R. J. (2012). Reproducing knowledge: Inaccurate replication and failure in franchise organizations. *Organization Science*, 23(3), 672-685.

Wooldridge, J. M. (2010). *Econometric Analysis of Cross Section and Panel Data* (2 ed.). Cambridge, MA: MIT Press.

Wu, G. A. (2012). The effect of going public on innovative productivity and exploratory search. *Organization Science*, 23(4), 928-950.

Zhou, K. Z., and Wu, F. (2010). Technological capability, strategic flexibility, and product innovation. *Strategic Management Journal*, 31(5), 547-561.

Zollo, M. (2009). Superstitious learning with rare strategic decisions: Theory and evidence from corporate acquisitions. *Organization Science*, 20(5), 894-908.

Zollo, M., and Singh, H. (2004). Deliberate learning in corporate acquisitions: Post-acquisition strategies and integration capability in U.S. Bank mergers. *Strategic Management Journal*, 25(13), 1233-1256.

Zollo, M., and Winter, S. G. (2002). Deliberate learning and the evolution of dynamic capabilities. *Organization Science*, 13(3), 339-351.

Implementing inbound open innovation in the CE industry. A case study of Philips-branded Televisions

Paul J. Hieltjes[1], Erwin H. Hieltjes[2]

[1] Hieltjes Innovation BV, Eindhoven, Netherlands
p.hieltjes@chello.nl

[2] Stockholm School of Economics, Stockholm, Sweden
40318@student.hhs.se

Abstract. Successful innovation requires a company to participate in open innovation and to be connected with the ecosystems around it. For consumer electronics industry, this article distinguishes knowledge, experience and legislation/certification ecosystems. In order to draw the necessary knowledge from ecosystems for inbound open innovation, companies should involve all functional areas in the gathering information and trends from the ecosystems. While most companies involve marketing, development, and production, two key areas for ecosystem knowledge gathering often remain untapped: purchasing and the participation in external standardisation bodies. Successfully using all functional areas to gather ecosystem knowledge will lead to the right innovations at the right time. Regular cross-functional meetings ensure the appropriate translation of collected information and knowledge into portfolio and development choices. The article illustrates this by the example of TP Vision, the makers of Philips-branded televisions, which has successfully applied this innovation process in the consumer electronics (CE) industry.

Keywords. Cross-functional, Ecosystem, Innovation, Open innovation Organisation of research, Product design, Purchasing, Research programme, Research and development, Standardisation

1 Introduction

Innovation accelerates rapidly and the speed of change is a challenge for every innovation manager. Many markets change so fast, fuelled by innovation, that it is hard to anticipate changes throughout the product development stages. The lead-time of new product development often exceeds the change rate in the market place. In order to innovate successfully, it is of utmost importance that businesses map-out their innovation ecosystem and track their partners and potential adopters (Adner, 2006; Iansiti and Levien, 2004). This approach mitigates the risks of offering the wrong product at the wrong time. Although the need for close monitoring of the innovation ecosystem has previously been identified (Adner, 2006), the most effective way to do so is still under debate. This paper describes a multi-disciplinary innovation approach and the benefits, when applying it in a fast changing environment like the Consumer Electronics (CE) market. The exemplary case used in this paper is the development of Philips-branded televisions in the company TP Vision. TP Vision concentrates on developing, manufacturing and marketing Philips-branded TV sets in Europe, Russia, Middle East, Brazil, Argentina, Uruguay, Paraguay and selected countries in Asia-Pacific. Based in Amsterdam, the Netherlands, TP Vision is the exclusive brand licensee of Philips TV for the above listed countries. The TV Company is 70% owned by TPV, headquartered in Taiwan, and 30% by Royal Philips, headquartered in the Netherlands. TP Vision employs close to 2000 people in

ISSN 2183-0606
http://www.open-jim.org

various locations around the world. (TP Vision, 2014)

2 The open innovation approach

Ever since Chesbrough (2003) coined the term open innovation, it has been a much-debated topic in the innovation literature. It can hardly be argued that in our international and interconnected world today, there still exists a pure form of 'closed innovation', in which a company innovates merely on the basis of their internal ideas and processes. Companies and research institutes are constantly subject to outside influences. Open innovation however requires a firm to consciously and purposely allow for information and knowledge in- and outflows to accelerate innovation (Chesbrough, 2006).

As open innovation is a broad term, it has since been used in many forms and situations, as noted by Huizingh (2010). An often-made distinction in order to structure the different forms of open innovation is the difference between inbound and outbound innovation, the former denoting the internal use of external knowledge, the latter denoting the external exploitation of internal knowledge (Huizingh, 2010). This case study focuses on inbound innovation: how can a company effectively use knowledge from outside its own circle in its innovation process. Sourcing ideas from the outside, does not warrant a company to abandon its own knowledge creation processes. As Dahlander and Gann (2010) note: "Internal capabilities and external relations are (…) complements rather than substitutes" (p.701). By sourcing the right amount, as well as the right sort of ideas, at the right time in the innovation process, open innovation can catalyse already existing innovation capabilities. This in turn can be valuable financially: "Firms that manage to create a synergy between their own processes and externally available ideas may be able to benefit from the creative ideas of outsiders to generate profitable new products and services." (Dahlander and Gann, 2010, p.704).

Current literature focuses on defining *what* open innovation is, *when* open innovation is practical and effective, and *how* to manage the open innovation process (Huizing, 2010). This case study aims to illustrate the latter: how to successfully implement open innovation. Generic frameworks have been offered in the literature, such as the five stage model by Walling and von Krogh (2010). However, although giving a guideline, such models still do not answer the question on *how* to specifically design and implement successful open innovation practices within an organisation. As Huizingh (2010) notes: "the internal process by which companies manage open innovation is still more trial and error than a professionally managed process" (p.6). Indeed, Dahlander and Gann (2010) note: "We have limited understanding of the process of sourcing this *(external knowledge)* into corporations" (p.707).

Moreover: "There is less research focused on the underlying decision process, which is important as firm face difficulties in maintaining large number of relations" (p.707). This paper aims to help fill such gap in the literature by providing a case study of precisely *how* open innovation can be professionally, systematically and successfully managed when involving a large number of external relations. First, the studies research question and methodology will be defined. Second, the open innovation practices at TP Vision will be structurally addressed, respectively discussing a) the mapping of the innovation ecosystem, b) the translation of knowledge from ecosystem to organisational knowledge, c) the portfolio decision process, and d) the measurement and monitoring practices. Lastly, the implications and limitations of the study are considered in order to make way for further research.

3 Methodology

They key questions to be addressed by this research is how to organise open innovation successfully, and how to optimise the decision process. As opposed to the often seen trial-and-error approach within the open innovation field, this study aims to provide a systematic example of successful open innovation, from information and knowledge sourcing up to final product decision.

The authors have chosen to select the case of TP Vision, a large (about 2000 employees), international (European and Asian innovation sites) company that operates in the fast-paced-innovation consumer electronics (CE) industry. The TP Vision method of organising open innovation has been used and developed for over 10 years and led to many successful innovations, such as Ambilight TV. Due to its success, the method has been copied by a number of business units within its former mother company, Royal Philips (e.g. the audio division). It is judged by many CE insiders as best practice, and can therefore offer good insides and examples for other companies on how to implement and organise open innovation. Up until now, its practices have not been described systematically, which is what this paper aims to bring to the table.

One of the authors has been responsible for the execution and improvements of the innovation process and, as such, has insights in the process. Furthermore, he was key stakeholder in the yearly process evaluation and effectiveness analyses. These internal effectiveness analyses (based on structured interviews with more than 10 key participants) were base on performance indicators such as "number of successful open innovation initiatives" and "business impact (success rate) of started innovation projects". The proven track record of TP vision's innovations, it's "example role" for different business units, as well as the consecutive positive internal evaluations warrant TP Vision to be an interesting and valid case study. Nonetheless, one has to take into account its context specific environment, such as the consumer electronics industry, when extrapolating its methods to other corporations, something that will be further addressed in the section 5.

4 Case study TP Vision

The innovation approach of TP Vision is described in this section. We start with a description of innovation ecosystems, in the light of the fast changing environment of the consumer electronics industry. Next, the question of how to translate knowledge from ecosystems into organisational knowledge is addressed. Based on this organisational knowledge, the management of a company has to make portfolio choices in the innovation programme. An organisational model to set priorities in the portfolio is described. As the lead-time of new product development often exceeds the change rate in the marketplace, an organisation has to organise it self to deal with this dynamics. Continue measurement, which will result in either adaptation of the portfolio or an improved decision process, does exactly this and is discussed in the last part of this section.

4.1 The Innovation Ecosystem

A business never operates as a stand-alone, but is always part of the environment around it. This (business) environment is the ideal source of information and knowledge that fuels open innovation. Before one can start harvesting the information

and knowledge from outside the company (see section 4.2), one has to first define where to look for this information: one has to define the business ecosystem. Using the words of Iansiti and Levien (2004), business ecosystems are loose networks- of suppliers, distributors, out-sourcing firms, makers of related products or services, technology providers, and a host of other organisations- that affect, and are affected by, the creation and delivery of a company's own offerings. The ecosystem therefore consists of a very wide variety of stakeholders relating to your business. It is the interaction with this ecosystem that can work as a catalyst with one's own capabilities to enhance innovation. There are several approaches to mapping such ecosystem, among others the Technological Innovation System developed by Utrecht University in cooperation with other European institutes like Chalmers University in Sweden and EAWAG in Switzerland, which offers 5 steps to a complete business ecosystem analysis. Although such comprehensive mapping might be academically desired, it can be superfluous in a real business situation. Mapping out the ecosystem has to serve a purpose: it has to identify those areas in which you can source the information and knowledge for future innovation. TP Vision has restricted the innovation ecosystems of its core business, the consumer electronics industry, to merely three sub-ecosystems that best capture the majority of the company's ecosystem. This way, there are three clear areas in which the company monitors activities and actively participates in knowledge and information gathering. In the case of TP Vision, those three ecosystems are: the knowledge ecosystem, the experience ecosystem and legislation/certification ecosystem. In other industries, the ecosystem might be simplifiable to other amounts of sub-ecosystems: the subdivision has to serve the purpose of clarity and parsimony; subdividing for the sake of subdividing is never recommended. The definition of the ecosystems for the consumer electronics industry as used in this case study are:

- Knowledge ecosystem: the environment to leverage the knowledge economy
- Experience ecosystem: the environment in which new use cases and new business models are defined
- Legislation/certification ecosystem: the technical environment in which the consumer electronics equipment is functioning (interfaces, content and services)

In consumer electronics, in-depth knowledge of all three ecosystems is needed to offer the best experience in every use case to the consumer. However, when developing a new feature for a consumer electronics product, a link to one of the ecosystems will be likely to be most dominant. However, the other ecosystems will also always play a role in the process, and are therefore equally important to monitor. In the next sections, each of the three ecosystems will be addressed in turn based on TP Vision examples. For every ecosystem a use case example in which the respective ecosystem prevails will be presented.

Knowledge ecosystem

The knowledge ecosystem in the consumer electronics industry is the environment of enterprises and knowledge institutions, which hold key expertise needed to improve the product performance. Good access to knowledge ecosystem is essential to reach breakthrough innovations.

An example of TP Vision in which the knowledge ecosystem was dominant, was concerning Ambilight, an innovation in which the TV picture extends with supporting surrounding light. In the case of Ambilight innovation, it all started with a project called Ambient Intelligent Lighting (Diederiks and Hoonart, 2007). This project started in 2002 as cooperation between Philips Research and Philips Lighting. Later the Business Unit TV was involved in the project. The role of Philips Research was to make the link to the academic world. The role of Philips Lighting was to support the

project with knowledge collected during the development of several lighting systems. Business Unit TV brought both parts of the Knowledge ecosystem together and introduced in 2004 the first Ambilight TV.

Experience ecosystem

The experience ecosystem concerns the environment in which new use cases and new business models are defined. The environment for TVs has changed drastically in the past 10 years, from analogue TV with a limited number of channels, towards the digital era with many digital channels and where a growing amount of information on internet can be accessed from the TV. This environment of services and content is named the experience ecosystem, and focuses to consumer experience. For more than a decade, companies are moving away from product and service, and focus towards consumer experience (Prahalad, 2003). Todays' customers do not only want to consume "experience", but they would like to co-create experience and have a personalised interaction. Making the right technology choice is fundamental to make a product ready for these services and to match the ease of use and ease of accessing content as required by the consumer. A wrong choice leads to a delay in market introduction and as a consequence to a significant drop in earnings.

An example of TP Vision in which the experience ecosystem was dominant, was concerning SMART TV, the integration of internet and user-interaction to the TV world. More than one third of the TVs sold today in Europe are SMART TVs (GfK, Q2 2013). SMART TVs are connected to the home network and/or internet. This enables the consumer to not only watch traditional TV (linear broadcast), but also to interact with social networks or a second screen. In figure 1, an example of elements of ecosystem used by TP Vision is given.

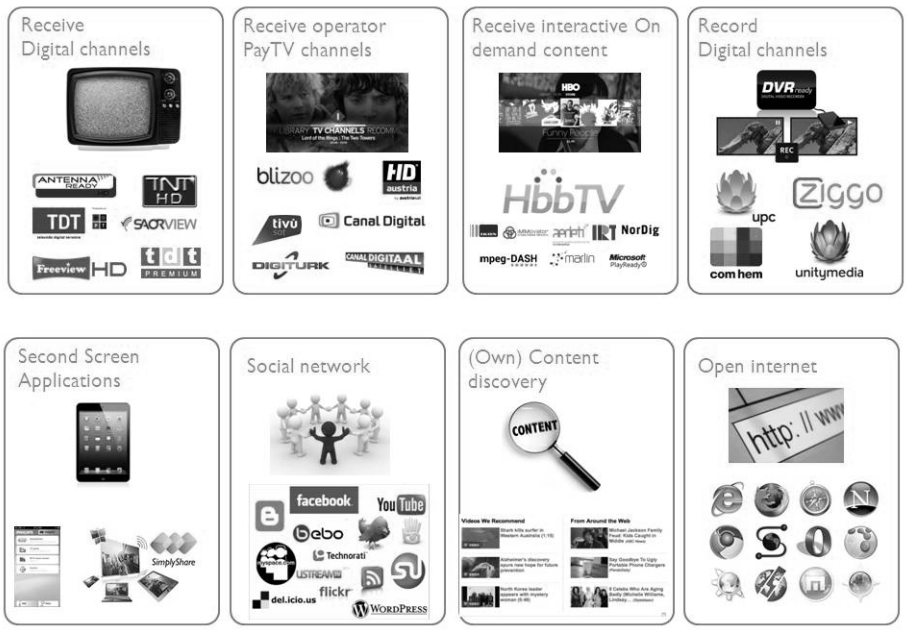


Fig. 1. The experience ecosystem of a TV. In the first line the more traditional use cases can be found. They show content which is also available via linear broadcast. In the second line the new interactive use cases together with examples of the ecosystem are illustrated.

The experience ecosystem is very dynamic. It is however influenced by marketing

campaigns of market leaders in the (adjacent) market (Dumenco, 2013). Knowing the consumer, competitor and substitution services/products is essential to create appealing products. Also knowledge of the main actors in such a system is essential. To act in such an environment, you need relations with the main companies in the ecosystem. This can be your supplier (e.g. Videoland), but also the supplier of your supplier (e.g. Disney).

Legislation/certification ecosystem

The legislation/certification ecosystem concerns the technical environment in which the consumer electronics equipment is functioning (interfaces, content and services). To bring a product to the market in time, this is the most important ecosystem. Every CE product has to pass certain certifications. Some basic certification related to safety or electromagnetic compatibility (EMC), but also certification requested by service providers (e.g. Netflix). The importance of this ecosystem is illustrated by Han van der Meer (2007). His research shows that 30 percent of the participating companies in the (Dutch) National Innovation Survey say that "legalisation, standards etc." are important factors, which hampers innovation in their companies. For a consumer, certification is an important buying criterion. For example, a Ziggo or UPC certification guarantees that a cable supplier gives you the needed support in case of bad signal quality or other artefact. Some certification or logos give the consumer the feeling to buy a future ready product (e.g. HD ready). Being able to offer products with such a logo is important for every CE suppliers. The legislation/certification ecosystem is influenced by governmental standardisation and defacto standards of large market parties. In many cases these standards are influenced by trade organisations (e.g. Digital Europe) or large companies (e.g. Dolby).

An example of TP Vision in which the legislation/certification ecosystem was dominant, was concerning Digital Right Management (DRM). Change of a certain DRM system has a major impact on the hardware and software architecture of a TV. Being able to predict the legislation/certification ecosystem is of utmost important to bring the right product on the right moment in an efficient way, especially during the early phases of product development, when key decisions on the product architecture are made.

4.2 Knowledge management

Having defined the innovation ecosystem for the consumer electronics industry, the question arises: How do you translate the information available in the eco-system in to organisational knowledge? This are in fact two questions. How do you get access to right information, and secondly, how do you translate this knowledge into organisational knowledge.

It is evident that it is impossible for one person or even one function to gather information and knowledge from all the innovation ecosystems. Most innovation organisation therefore involves the development, marketing and production departments, in order to leverage on ecosystem knowledge. At TP Vision, those departments are also used as a source of ecosystem information and knowledge. However, TP Vision puts emphasise on two extra and vital input modes, which are often untapped: the purchasing department, and participation in standardisation bodies. Both are important areas of information and knowledge sourcing and will be discussed in turn. Subsequently, the second question, how do you translate this knowledge into organisational knowledge, will be addressed. TP Vision's organisational structure, including so-called 'Triangles', will be outlined as an example for other companies. Moreover, a special focus is put on the embedding of standards knowledge in the innovation process.

Extracting knowledge from the ecosystems: the role of purchasing

In many companies product development is handled by development, marketing and production. Knowing the external environment is often assumed and organisations seldom have a specific function/role to stimulate the leverage of the knowledge of the ecosystems. The role of purchasing is often limited to negotiating the contract with component or knowledge suppliers. However, at TP Vision, the role of (initial) purchasing is extended into all phases of the development process, including product concept and feasibility. The main role of purchasing (in this context) is to research known ecosystems.

Next to the traditional role to monitor the cost price, purchasing plays a key-role in discussions during a project gate meeting. At TP Vision, purchasing has to ensure the outward looking attitude from the first gate meeting onwards. Initial purchasing facilitates analyses of the three ecosystems. Aspects they focus on are:

- Assessment of the momentum of an upcoming technology or standards
- Assessment of strength of content partners, to facilitate a new use case in the experience ecosystem
- Assessment of knowledge partner's capability to deliver the right functionality, in time against the right costs (insight in cost drivers and cost curves)
- Scouting, in case capabilities are found to be missing
- Long term partnership opportunities with key suppliers

Including the purchasing department as described above, can significantly increase the uptake of knowledge from the ecosystems, and is likely to be an underused knowledge source by many companies.

Based on more than 10 years of experience, we can say that including purchasing results in the following advantages:

- Additional view on the external environment
- Better prediction of trends, due to the contacts with second and third tier suppliers
- Constructive challenge to the attitude in development to choose an in-house solution (Not Invented Here)
- Triggering early supplier involvement during the product concept or feasibility phase

Extracting knowledge from the ecosystems: the role of standardisation

Standardisation is, within TP Vision, an area where ecosystem linkage is the lead theme. Participation in standardisation committees is an, often undervalued, opportunity to predict the trends in the innovation ecosystem.

Some companies use the knowledge collected during standardisation activities only during the final phase of the development process. In this final phase the knowledge is used to check the conformance with the requirement specification approved by marketing. In case of a TV product, certifications with the latest standards/logo requirements are essential. In many cases product requirements change during the development phase of a TV product, due to new legislation or new certification requirements. Not meeting these requirements will lead to a drop in sales. The only way to avoid delay in market introduction is to predict these changes and prepare the architecture/software for these adjustments. The prediction of changes in the ecosystem is done before a project is actually started.

Another important factor to ensure the assimilation of the knowledge of people working in standardisation is the choice of having part-time standardisation roles.

Next to a knowledge-gathering task and influencing the external environment, every participant in standardisation activities also participates in internal projects in his field. In this way, TP Vision assures that the filtering of information is done based on the actual needs of the organisation. People participating in standardisation bodies can be found in marketing, but in most cases they work in the development function. They collect and assimilate information from the (legislation/certification) ecosystem in the CE industry, and the assimilation of the knowledge is done via discussions in the relevant triangles (see next section).

Translating ecosystem knowledge into organisational knowledge

Having collected the information and knowledge from your ecosystems, the next step concerns translating this knowledge into organisational knowledge. This part of knowledge management is a critical element in the innovation process. In order to make the right selection when information is abundant, the inclusion of all disciplines/functions in this process is essential. This has to be combined with a good knowledge management system and good interaction with key players in the organisation (Rothberg and Erickson 2005). The use of the gained knowledge starts already when filling in the details of the strategic innovation plan. At TP Vision this is made explicit in a document: the Long Term Product Plan. Next to the strategic plan, roadmaps and analyses of the relevant ecosystems should be used.

As previously discussed, in order to fully anticipate changes in the innovation ecosystem, businesses should include main actors in the relevant eco-systems in their innovation process. When involving development, marketing, production, as well as, purchasing and standardisation, elements like human interactive capabilities and experience on knowledge transfer on interpersonal or departmental levels are important (Rothberg and Erickson 2005). TP Vision therefore organises cross-functional meetings for knowledge management, which will be described below. Dependent on the dominant ecosystem, different disciplines are involved. In the specific case of TP Vision, it typically concerns:

- Knowledge ecosystem: research group, purchasing, development
- Experience ecosystem: marketing, purchasing, development, new business development
- Legislation/certification ecosystem: development, marketing, production

At TP Vision, a structure with monthly meetings forms the fundaments of the knowledge management system. Multiple meetings run parallel, each focusing on part of TV use case. An example is the “viewing experience” use case, focusing on all aspect of an optimal viewing experience. A (triangle) meeting consist of 5 till 10 people, who are active on the senior level in their discipline. Examples are system architect, senior designer, product manager or initial purchaser. Participants of these monthly “Triangle-meetings” discuss the trends in the relevant ecosystems. The word Triangle is chosen to emphasise the three pillars responsible for innovation at TP Vision: marketing, development and purchasing. For companies competing in the CE space, the function of purchasing is important, as for most CE companies following the cost-curve is essential to survive. Equally important is the aspect that purchasing stimulates the outward looking attitude. In a business so depending on ecosystems, outward looking attitude is essential to gain market share. The buying decision of a TV consumer is not only based on the basic function (watching linear content), but also on the promise to be part of a (personalised) ecosystem (driven by social media). Having future-proof partners is necessary to have an effective development process. One of the standard agenda points of a “Triangle-meeting” is the assessment of (potential) partners.

Having a number of parallel (experience focused) triangle groups has a number of

advantages. On one hand it supports active involvement of purchasing and marketing in the triangle meetings, as the discussion are related to the same type of topics. The time spend on these meeting is perceived as well invested. On the other hand each experience domain gives a different weight to the three eco-systems as can be seen in in figure 2. Having focused triangle teams ensures that the external analysis is relevant for all participants.

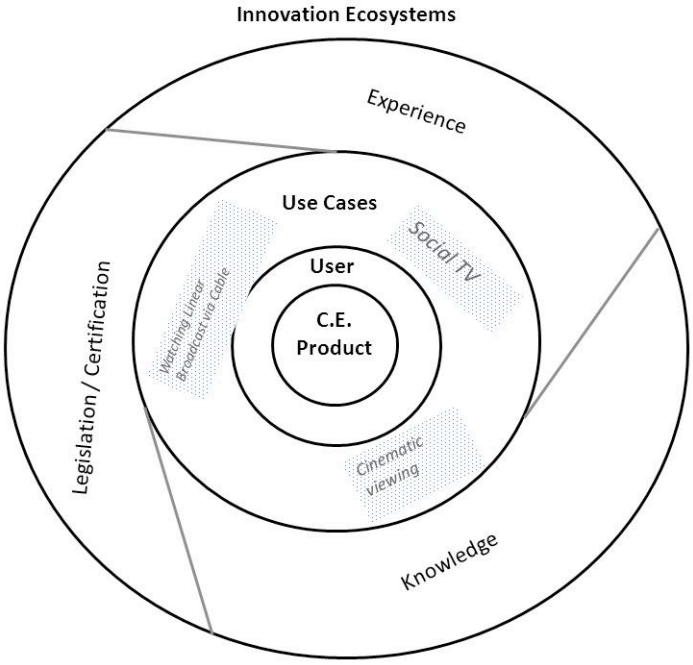


Fig. 2. Innovation ecosystems in the consumer electronics industry. In the centre the product and user can be found. Based on the use-cases the relevant environment is defined. The relevant ecosystem is separated into knowledge, experience and legislation/certification ecosystems.

TP Vision recognises that information collected by participating in standardisation is relevant for a (experience) domain as well for business strategy. Next to triangle meetings an extra cross-functional meeting is organised to leveraging the many valuable contacts standardisation participants have within the innovation ecosystem. In for example marketing working groups, people have valuable knowledge on trends in the experience ecosystem. In the technical working groups, people are connected to the knowledge ecosystem. Quarterly meetings between TP Vision standardisation people and management of development and marketing are planned to align business strategy and standardisation policy. In these quarterly meeting the portfolio of standardisation projects is assessed. If needed, the meeting leads to new initiatives to create industry standardisation (e.g. SMART TV alliance).

4.3 Portfolio choices

Today we live in a time of information abundance and making the right choice (what "to do", or "not to do") is difficult. The same holds for portfolio management for innovation. Portfolio management can become a competitive advantage if a company uses all the knowledge available in the company to make the right portfolio choices.

This means that all functions involved in innovation should also be consulted in case of portfolio choices. Elicitation, the process of capturing the tacit knowledge, i.e. knowledge that is a mixture of deliberation, subjective insight, intuitions, heuristics, and judgments, is salient in this respect (Bayney and Chakravarti, 2012). Once captured, this knowledge should translate in clear strategic choices.

Within TP Vision the aforementioned "Triangle-meetings" are an essential input for program management to make decisions. The monthly "Triangle-meetings" are also used to review the progress of the product concept and feasibility portfolio and they advise program management to stop or change the projects based on changes in the environment.

Strategic shifts in priority between the several domains are made on a half yearly *Golden Triangle*. In the half-yearly meeting, main decisions related to the innovation portfolio are made. The domain triangles present the trends in their domain, and based on a SWOT analysis and business assessment, a project portfolio is proposed. A business management team, representing development (e.g. CTO, Chief Technology Officer), marketing (e.g. CMO, Chief Marketing Officer) and purchasing (e.g. CPO, Chief Purchasing Officer) decides in the Golden triangle for shifts in the total innovation portfolio.

Figure 3 below gives an overview of the triangle structures at TP Vision. The monthly triangle meetings discuss trends in the relevant ecosystems concerning a particular domain among the senior management. The half-yearly Golden triangle meetings then set out the choices in portfolio management, based on the domain triangles' input.

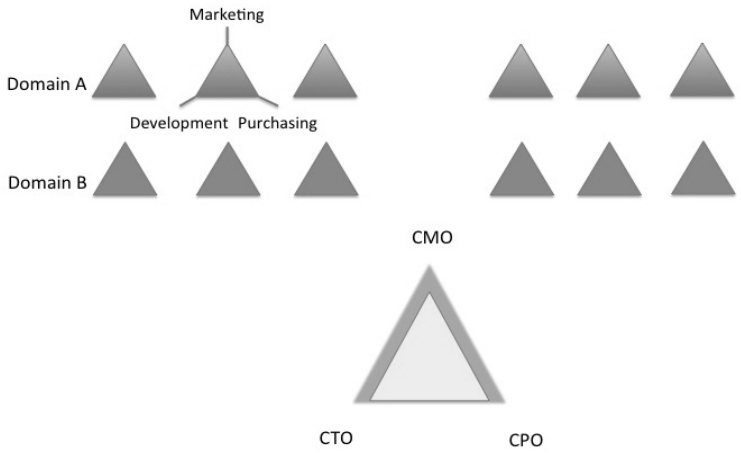


Fig. 3 The triangle structure of TP Vision, with the monthly domain triangles on top and the half-yearly golden triangle below.

4.4 Adapting the development process to the fast changing environment

Making the portfolio choice is based on the available knowledge. In a dynamic environment these choices have to be adapted in case of major changes in this environment occur. At TP Vision therefore measures and checks at several moments, whether the ecosystem feedback is still incorporated in the product development, as will be described this section. Moreover, in order to ensure a lasting winning innovation strategy, the knowledge management process is tuned regularly to the new environment, based on rigorous evaluations.

Adjustments of the choices during development

As many companies, TP Vision uses a stage-gate method during the development of its new products and services. During this process, it is important to check the link to the ecosystem for feedback and input at the correct moment. Proper and timely linking of the ecosystems to the stage-gate process is key to reaching market success. Each ecosystem will play a varying role in at the different stages of the process. In the figure below, a stage-gate process (as in among others: Alexio (2009)) is shown with the respective involvement of the pre-defined ecosystems, as based on experience.

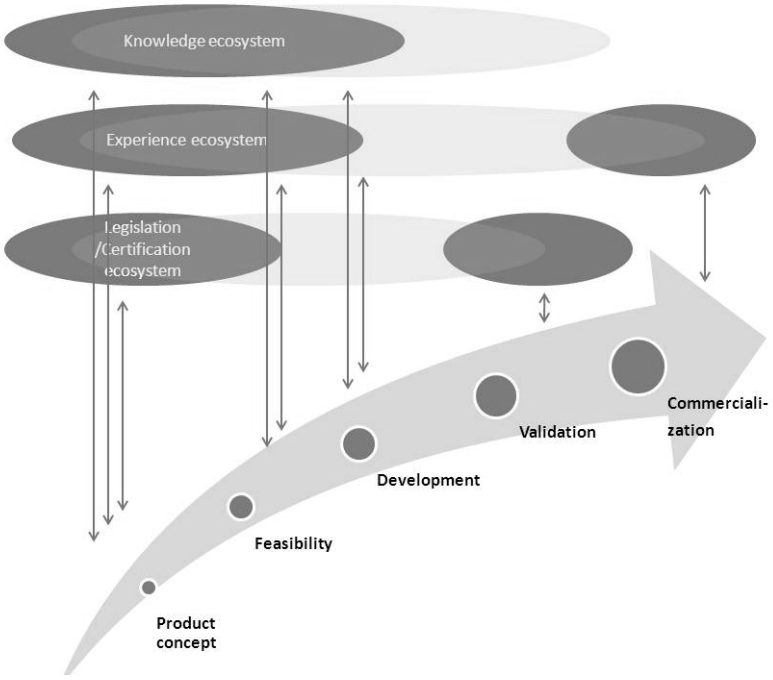


Fig. 4. Stage-gate process interacting with the ecosystems.

Although varying case by case, the product concept and feasibility phase usually encompass monitoring of, and interaction with, all three ecosystems, as all ecosystems need to align in order to make the idea conceivable. During the development phase, the knowledge and experience ecosystems prevail as the leading force of development. Once the product has been developed, the legislation/certification ecosystem will be intensively utilised, in order to ensure compatibility. Finally, during the commercialisation phase, the experience ecosystem takes the upper hand. Figure 4 gives a typical example of the linkage of the ecosystems with the development phases.

TP Vision uses the gate meetings to validate if the prediction of the ecosystem is still valid and if changes in the ecosystem need to be taken into account. This implies that it is essential to involve all disciplines in the preparation of gate meetings. The results of the previous phase, is presented with regards to the future ecosystem. During the project gate meetings, program management decides whether to continue with a project programme or not.

Tuning the knowledge management process

The Triangle system has been applied for several years and a yearly effective analysis has been done. The purpose of the Triangle system is, to validate the knowledge gained from the ecosystem and translate this knowledge into the best innovation initiatives.

During the yearly evaluation the effect of the last year's innovation cycle is evaluated. During the same evaluation also the effect of the innovation started three years ago is evaluated. The main criterion of the assessment is: Has the programme contributed to the competiveness of the key product range?

The effectiveness of the Triangles is per domain assessed and the learnings are applied to improve the quality of the monthly triangle meetings (meeting agenda, underpinning of proposals and assessment/reporting of trends in the eco-system). To guide the improvements, key metrics are collected per triangle (e.g. number of open innovation project started with external partners).

5 Implications and limitations.

In section 4, the case of TP Vision illustrates, how to map your ecosystems, how to translate ecosystem knowledge into organisational knowledge and how to organise the decision process. The methods have been successfully tested by several Business Units of Royal Philips. Based on their experiences, several context specific factors have been determined that make the described approach successful. Elements that prove to contribute to a successful application of this system are:

- A fast changing environment like consumer electronic industry
- A short product lifecycles and fast feedback of the market
- A flat organisation structure, where bottom up initiatives are valued
- A culture where cross-functional cooperation is encourages
- Incremental innovations are taking large part of the innovation budget
- A strong strategic purchasing role

Companies and industries that can familiarise themselves with the aforementioned factors are likely to benefit from implanting a similar approach to open innovation as TP Vision. There are however also elements, which make the application of the described process more difficult. Specifically:

- A top down culture
- Organic organisation growing via entrepreneurial behaviour of a few individuals.
- Business units with less than 40 persons based in one location (e.g. focusing on one breakthrough innovation).
- Business with mainly outsourced research and development activities.

As the implementation of open innovation strategy is always context specific, it would be beneficial if future research identifies the approaches of companies in other industries and environment. Building a literature of multiple cases of how to implement open innovation, will allow researchers to identify parallels and key concepts that can be applied generically, as well as more context specific elements. Lastly, more systematic research on the involvement of purchasing in collecting ecosystem knowledge, as well as the involvement of standardisation bodies, is warranted, as the current literature seems to large ignore its importance in the innovation process.

6 Conclusion

An active link to relevant ecosystems is essential in inbound open innovation. Every discipline should have a defined role in linking to these ecosystems. A good elicitation procedure and usage of this collective knowledge is needed for an optimal innovation process. While most companies involve only marketing, development and production in the innovation process, the TP Vision case shows the potential of also involving employees working in (initial) purchasing, as well as those employees representing a company in external (standardisation) bodies. This can lead to a big step forward in the innovation performance of companies working in the consumer electronics (CE) industry, as more salient information and knowledge is extracted from the relevant ecosystems.

In order to translate the ecosystem knowledge into organisational knowledge, the organisation of the knowledge management system plays a key role. The TP Vision case advocates monthly regular cross-functional triangle meetings at domain level, combining marketing, development and purchasing, to ensure structural access to the ecosystems. In turn, half-yearly Golden triangle meetings combine the different domain triangles in order to make strategic portfolio choices. As the CE environment is changing rapidly, regular alignment check-ups of the ecosystems and product development are planned during the several stages of the stage-gate innovation process. In combination with regular evaluations of the system, this ensures that the TP Vision open innovation approach stays up to date and remains effective.

7 References

Adner, R. (2006). Match your innovation strategy to your innovation ecosystem. *Harvard business review, 84*(4), 98-107.

Bayney, R. M., & Chakravarti, R. (2012) *Enterprise Project portfolio Management: building competencies for R&D and IT investment success*. Plantation.

Chesbrough, H. W. (2003). *Open innovation: The new imperative for creating and profiting from technology*. Harvard Business Press.

Chesbrough, H. W. (2006). The era of open innovation. *Managing innovation and change, 127*(3), 34-41.

Dahlander, L., & Gann, D. M. (2010). How open is innovation? *Research Policy, 39*(6), 699-709.

Diederiks, E. M., & Hoonhout, H. J. C. (2007). Radical innovation and end-user involvement: the Ambilight case. *Knowledge, Technology & Policy, 20*(1), 31-38.

Dumenco, S. (2013, July 19). *Introducing the Social-TV Ecosystem Chart 2.0. Adage.com*. Accessed December 10, 2013, from http://www.adage.com.

GfK (2013) *market report Q2 2013*. Accessed 3th December 2013. http://www.gfk.com/news-and-events/press-room/press-releases/Pages/Consumer-electronics-growth-in-innovative-segments.aspx.

Huizingh, E. K. (2011). Open innovation: State of the art and future perspectives. *Technovation, 31*(1), 2-9.

Iansiti, M., & Levien, R. (2004). Strategy as ecology. *Harvard business review, 82*(3), 68-81.

Rothberg, H. N., & Erickson, G. S. (2005). *From knowledge to intelligence: Creating competitive advantage in the next economy*. Routledge.

TP Vision (2014) *about us*. Accessed 28th January 2014. http://www.tpvision.com/about-us.html.

Van der Meer, H. (2007). Open innovation–the Dutch treat: challenges in thinking in business models. *Creativity and Innovation Management, 16*(2), 192-202.

Wallin, M.W., & von Krogh, G. (2010). Organizing for open innovation: focus on the integration of knowledge. *Organizational Dynamics 39*(2), 145–154.

Antecedents of Innovativeness: Entrepreneurial Team Characteristics and Networking

Dilek Turan[1], Semra F. Aşçıgil[2]
1Faculty of Economics and Administrative Sciences, Middle East Technical University, Department of Business Administration, Ankara, Turkey
dilek_tuten@hotmail.com
[2]Faculty of Economics and Administrative Sciences, Middle East Technical University, Department of Business Administration, Ankara, Turkey
sascigil@metu.edu.tr

Abstract. This paper highlights the impact of entrepreneurial team demographics and networking on organizational innovativeness in a sample of SMEs located in northwest Turkey. The findings revealed that entrepreneurial team characteristics (age heterogeneity and average education) played a significant role in organizational innovativeness of SMEs after controlling team size. Networking with public organizations played an important role in contributing to innovativeness capacity whereas networking with competitors had a marginal role. The findings suggest substitutability between entrepreneurial team characteristics (average education) and networking which can offer more flexibility in the policies of public organizations and educational institutions.

Keywords: Networks, Entrepreneurial Teams, Innovativeness, Small and Medium-sized Enterprises

1 Introduction

Mortality of SMEs is argued to be quite low and research concludes that survival can be achieved through acquiring a propensity to create (Desphande and Farley; 1999, 2000). Innovation process involves exploiting an opportunity through which entrepreneurs combine resources in a novel way that would enable them to survive. Organizational innovativeness is a means for change (Damanpour, 1991), yet differs from change with an intentionality of direct benefit and newness (West and Farr, 1990). Although research on innovativeness produced numerous findings, the results were inconsistent (Downs and Mohr, 1976) as each focused on different aspects of innovativeness (Varis and Littunen, 2010). The variety in approaches prevented cumulative contributions to the concept. Past research mostly focused on product innovativeness (Griffin, 2002) neglecting the importance of other dimensions such as market and process that contribute to overall innovativeness of organizations.

Entrepreneurs utilize both tangible and intangible resources they possess in order to enhance innovativeness. It is argued that small firms' ability to use external networks (Noteboom, 1994) help to remedy the shortcomings of smallness (Hakansson and Snehota, 1990) in identifying innovative opportunities. Networks bring new knowledge and information that is vital for firm innovativeness (Bell, 2005). Moreover, entrepreneurial team characteristics are yet another factor whose direct impact on strategic issues such as innovativeness has been demonstrated by the work of Wiersema and Bantel (1992). However, past researchers have either studied relationship of human or social factors and innovativeness, taking samples of entrepreneurs rather than entrepreneurial teams (Seghers et al., 2012), or explored the

ISSN 2183-0606
http://www.open-jim.org

effect of only one of the above mentioned variables (networks and entrepreneurial teams) on innovativeness (Molina-Moralez and Martinez-Fernandez, 2010).

The purpose of this paper is to clarify whether networking and entrepreneurial team characteristics are antecedents of organizational innovativeness. Organizations' overall innovativeness capability will be the basis of our understanding in operationalizing the construct. The paper is organized as follows. First, a review of the literature on the concepts of innovativeness, entrepreneurial teams and networking is provided. Second, the findings on the relationship between innovativeness and the two independent variables (entrepreneurial team characteristics and networking) are reviewed in order to develop and justify the hypotheses. Third, the methodological background and research findings are introduced. Last, the discussion and limitations of the research are presented.

2 Innovativeness, entrepreneurial teams, and networking

Wang and Ahmed (2004) defined an organization's overall innovativeness construct as "introducing new products to the market, through combining strategic orientation with innovative behavior and process." According to the authors innovativeness implies the propensity for constant innovation. The five interlinked areas they identified are product innovativeness, market innovativeness, process innovativeness, behavioral innovativeness and strategic innovativeness. Product and market innovativeness are externally focused and market based, while process and behavior innovativeness are internally focused. Strategic innovativeness, on the other hand, emphasizes an organization's ability to detect external opportunities in a timely fashion and match external opportunities with internal capabilities in order to serve innovative products and explore new markets or market sectors. These five aspects together represent an organization's overall innovativeness (Wang and Ahmed, 2004).

Organizations vary widely with regard to their capacities to innovate (Cohen and Levinthal, 1990). The resource dependency theory of organizations emphasizes the importance of both internal and external resources in company performance in capturing a mode of innovativeness (Varis and Litunen, 2010; Barney, 2001; Peteraf, 1993). Although past research focused on the entrepreneur as a person in developing processes (North and Smallbone, 2000), recent literature emphasizes the importance of entrepreneurial teams whose trait combinations/characteristics are major assets for innovativeness (Carpenter, 2002) and family firm performance (Ling and Kellermanns, 2010). The concept of entrepreneurial teams has been built on top management teams research (Hambrick and Mason, 1984). Üçbaşaran et al. (2003) defined entrepreneurial teams as comprising members who hold significant ownership stakes and are involved in strategic planning. Research has shown the superior performance of ventures owned by entrepreneurial teams relative to those owned by solo entrepreneurs (Cooper and Bruno, 1977). Top management teams' involvement becomes more intense in small businesses as a consequence of their size and flexible structure (Brunning et al., 2007). Therefore, the capacity created by diverse entrepreneurial teams attains particular importance in developing innovation strategies and acknowledging their knowledge and experiences inducing use of resources in a unique way.

Upper echelons theory, which pioneered interest in teams at the top, indicates that the demographic characteristics of top executives are related to major organizational outcomes (Cannella et al., 2001). The larger the combined set of skills and experiences, the more successful they are in addressing complex issues such as innovativeness. Similarly, heterogeneity begets dynamism that helps in accessing networks to find creative solutions to pressing problems (Carpenter et al., 2004).

Heterogeneity may be due to different sources and literature distinguishes between job-related (factors such as background, education, and tenure which capture task relevant skills and experiences) and non-job related (age and gender) heterogeneity. Research identifies job-related heterogeneity as provoking more salient outcomes in strategic dynamism than the latter (Naranjo-Gil et al., 2012). However, heterogeneity is a double edged sword as negative effect of team heterogeneity was also identified on exchange of information as well as integration of differential knowledge within top management teams (Li, 2012).

While internal resources such as entrepreneurial team characteristics are critical to innovativeness, connections with external knowledge sources complement the resources that small businesses are deprived of. Hence, top management team characteristics alone may not be enough to predict organizational outcomes and consideration of other predictor variables such as networking may lead to more value-adding contributions in research (Carpenter, 2002). Networks are valuable for bringing innovation-specific resources and expertise for entrepreneurial teams to exploit (Rothwell, 1991; Zaheer and Bell, 2005). Firms' desire to obtain needed information (Hendry et al., 1995) and knowledge opportunities (Brunetto and Far-Wharton, 2007) have been cited among primary justifications for networking.

Evidence as to the importance of networking has been provided by different theories. Organizational learning theory explains innovativeness capacity through an inherent learning process. Small businesses exchange resources and information with external resources to incorporate skills, knowledge and behaviours into their existing sets of skills. Throughout exchange processes, learning needs of entrepreneurial teams are met by means of various external relationships that advance innovativeness capacity of the entrepreneurial team. Social capital theory yet brings another perspective that highlights the importance of social networks. By creating a context for social interactions, social capital facilitates the formation of new linkages (Tsai, 2000; Spence et al., 2003) that boost innovativeness.

Social capital is a relational source featured in exchange relations that enhance the level of knowledge through impacting quality of information, frequency of interaction and the degree of trust in these relations (Nahapiet and Ghoshal, 1998; Greve and Salaff, 2003). Complementing their own resources, small businesses build networks to exchange resources (Massa and Tessa, 2008). Based on the quality of exchange relations, the information accessed by the entrepreneur earns usefulness as well as reliability. Networks developed with various stakeholders are instrumental for providing information and knowledge. Stakeholders such as government agencies, universities, suppliers and competitors are critical in their influence on innovativeness (Gibb, 1995; Greve and Salaff, 2003). However, the impact created varies depending on the type and nature of linkages. Vertical linkages such as suppliers and customers influence cost reduction, risk-sharing opportunities and timeliness. Horizontal linkages such as competitors, universities, and public agencies, on the other hand, complement know-how (Tidd et al., 1997; Massa and Tessa, 2008).

According to Jack (2005), entrepreneurs' aim in developing ties is not restricted by overcoming weaknesses due to newness. Besides, networks are tools to acquire social capital, which is essential for innovativeness. However, it should also be acknowledged that how networks are utilized is of greater critical importance than merely having networks (Jack, 2005). Using weak and strong ties concepts, Jack (2005) admitted that strong ties developed with stakeholders were important in providing information and knowledge for innovation, as well as enhancing the business and personal reputation (Jack, 2005). Elfring and Hulsink (2007) also used strong and weak ties concepts in a case study where different patterns of network development were identified. Networks display a dynamic nature where weak ties are abandoned more often than strong ones. Moreover, networks are sought to gain

information as well as legitimacy. Legitimacy equips the founders with network development capabilities. But at the same time, limitations are signified whereby network overload hinders utilization (Elfring and Hulsink, 2007).

In their research focusing on the effect of interorganizational social capital on start-up firms, Pirolo and Presutti (2010) showed that both strong and weak social capital affect the growth of start-up firms throughout their life cycle. Moreover, they verified that weak ties with customers influence innovation performance growth, while strong ties, which form a significant social liability, have an inhibiting effect during their entire life cycle. In all this research (Jack, 2005; Elfring and Hulsink, 2007; Pirolo and Presutti, 2010) a consensus over the dark side of the networks was reached in that having too many strong ties may inhibit access to new information.

On the other hand, Ahuja (2000) distinguished among technical, commercial and social capital in terms of influencing the linkage formation behavior. In his study of chemical firms focusing only on interfirm networks, he argued that ability to collaborate with other firms was to a great extent influenced by the commercial capital (supporting assets needed in commercializing an innovation) and therefore not evenly distributed across firms. However, firms with technical capital (capabilities in creating new technology, products, and processes) could still develop alternative paths for collaboration with other firms, such as joint ventures or technology agreements. Social capital, on the other hand, plays a facilitative role by providing both informational and reputational benefits to collaborating firms. Through social capital development, firms engage in joint ventures more confidently as it allows the gaining of prior insight as to the predictability of behaviours of other firms (Dakhli and De Clercq, 2004).

3 Development of hypotheses

3.1 Entrepreneurial team demographics and innovativeness

Since SMEs lack most of the resources large firms have for use in innovative activities, what individuals know becomes extremely important (Wicklund and Shephard, 2003). Although there is substantive research in large firms pertaining to the role played by top management team characteristics in enhancing innovativeness (Wiersema and Bantel, 1992; Canella et al., 2001; Camelo-Ordaz et al., 2005), little is done to address whether this is equally important in SMEs. Because of liability of smallness being the major constraint, the entrepreneurial human capital emerges as a critical factor to exploit (Davidsson and Honig, 2003; Shrader and Siegel, 2007). Below are the salient entrepreneurial team demographics and the crucial role they play in determining innovative capacity as discussed in the literature.

Gender Heterogeneity: As a demographic variable, gender has drawn the attention of many researchers upon increasing number of women entering business life. Gender heterogeneity was found to be associated with higher quality solutions (Hoffman and Maier, 1961; Sethi et al., 2002), creative decisions (Zaidi et al., 2010) and better performance (Wood, 1987). Gender diversity has a positive impact on innovativeness because of the differences in the nature of women and men that in turn enhance team performance in innovative activities. Thus, we propose:

> *Hypothesis 1: There is a positive relationship between gender heterogeneity of entrepreneurial teams and innovativeness.*

Average Age: As was found by many researchers, management team youth affects innovative activities of the companies positively (Child, 1974; Hambrick and Mason, 1984; Bantel and Jackson, 1989). Three explanations for this association can be seen in the literature. First, as Child (1974) contended, younger managers possess the

ability to spend more physical and mental effort to bring change to their companies. Moreover, their learning abilities, reasoning and memory are better than older managers which help them to come up with new ideas and learn new behaviors (Botwinick, 1977; Burke and Leah, 1981). Second, an advantage is created in terms of the more sophisticated technical knowledge acquired by younger managers during their education (Bantel and Jackson, 1989). Finally, younger managers are more eager to take risky actions than older managers (Vroom and Pahl, 1971; Hambrick and Mason, 1984).

In contrast, it is argued that older managers avoid risky behaviors to maintain their financial and career security since their expenditure habits are already established (Carlsson and Karlsson, 1970). Old age employees are less creative and slow in adapting to change (Taqi, 2002). Moreover, youthfulness also poses limitations on innovativeness. According to Kitchell (1997), very young managers searching for opportunities at early stages of their career may fail to make a long-term commitment or champion radical changes. Taking the opposite arguments into account, it can be deducted that the relationship between an entrepreneurial team's average age and innovativeness, while negative, is curvilinear at the extremes (for very young and very old entrepreneurial teams). Since the findings indicate a potential curvilinear relationship beyond a simple linear relationship, we propose:

> *Hypothesis 2: There is a negative curvilinear relationship between average age of entrepreneurial teams and innovativeness.*

Age Heterogeneity: Contradictory views are found on the effect of age heterogeneity on innovativeness by researchers. Age heterogeneity increases the innovativeness of teams because different age groups have different attitudes, values and perspectives due to their experiences of different social, political and economic environments and events which boost group creativity (Leonard and Sensiper, 1998; Glass, 2007). However, heterogeneity is avoided since it inflates negativity and leads to higher levels of conflict (Hartel, 2004). Conflict obstructs group cohesiveness which is necessary for teams to decide on strategic actions like innovations. On the other hand, Bantel and Jackson (1989) in their research in the banking sector found no significant relationship between the two variables. Hence we propose:

> *Hypothesis 3: Innovativeness of entrepreneurial teams is influenced by their age heterogeneity.*

Average Organizational Tenure: Hayes and Abernathy (1980) stated that a manager working in a particular company for long periof of time can develop knowledge of the technological trends unique to the industry which in turn encourages him to engage in innovation capitalizing on such knowledge. On the other hand, Hambrick and Mason (1984) proposed that managers who have worked in the same company for many years develop a kind of loyalty to their existing products and markets which prevents them from looking for new ones. Similarly, Bantel and Jackson (1989) pointed to managers' psychological commitment to the status quo - a factor decreasing the need for information search. Similarly, Brunning et al. (2007) claimed that over time, managers may become insulated from changes in business environment and inevitably fail to perceive and react to change. Thus, considering these arguments, a negative curvilinear relationship is proposed:

> *Hypothesis 4: There is a negative curvilinear relationship between average tenure of entrepreneurial teams and innovativeness.*

Organizational Tenure Heterogeneity: As in the case of age heterogeneity, cohort groups defined by organizational tenure are likely to be different from each other with respect to their experiences, perspectives, attitudes and values. Although heterogeneity may add cognitive diversity and encourage discussion, these differences may at the same time promote conflict and obstruct communication processes among

members creating a barrier for innovativeness (Katz, 1982; Bantel and Jackson, 1989). Therefore, we propose:

Hypothesis 5: Innovativeness of entrepreneurial teams is influenced by their tenure heterogeneity.

Average Education Level: A manager's formal educational background has been accepted as a sign of his/her values and cognitive abilities in many studies. Moreover, a positive relationship with top management teams' average education levels and their commitment to innovation was found (Kimberly and Evanisko, 1981; Hambrick and Mason, 1984; Bantel and Jackson, 1989; Daellanbach et al., 1999) which indicated that teams having higher education levels had an ability to bring creative solutions to more complex problems, and were more receptive toward innovation. Therefore, we propose:

Hypothesis 6: There is a positive relationship between average education level of entrepreneurial teams and innovativeness.

3.2 Networking and innovativeness

Networking with Customers: It has been argued that there is scope for considerable gain through involving the user in the product design and development processes (Rothwell and Gardiner, 1985; Thomke and Von Hippel, 2001; Prahalad and Ramaswamy, 2004). These gains are believed to be four-fold. First, internal design and development activities may be supplemented by getting access to the technical and managerial skills of their customers. Second, user involvement is an ideal way of establishing the optimum price/performance combination and ultimately the optimum specifications. Third, involving the user in the product design and development stages reduces the post-delivery learning required on their part. Finally, where user involvement stimulates a strong relationship, this may result in user feedback and associated product improvements that serve to lengthen the product life span (Rothwell and Gardiner, 1985; Freel, 2000). Von Hippel and Katz (2002) claimed that agency costs will be incurred whenever users delegate design to manufacturers and thus, underlined the importance of providing users with the incentives for participating in innovation. In support of these views, Freel (2003) later found a significant positive relationship between having links with customers and new product innovations. Therefore, we propose:

Hypothesis 7a: There is a positive relationship between networking with customers and innovativeness.

Networking with Suppliers: Networking with suppliers enhances competitiveness (Ramcharran, 2001) with an ultimate effect on innovativeness capability (Rothwell and Dodgson, 1991). Since bought-out items account for a significant percent of total costs (Turnbull et al., 1992) in many industries, it is evident that the supplier relationship has an important role in determining competitiveness and ultimately, innovative capability. In their review, Rothwell and Dodgson (1991) found that in cases of significant innovation, 10 percent of innovations involved collaboration with customers only, compared to 55 percent that involved collaboration with both customers and suppliers. Exploring the degree of linkages between automotive parts suppliers and automobile manufacturers, Ramcharran (2001) also found significant linkages manifested by high correlation coefficients of the price-to-earnings ratio of auto parts suppliers and auto manufacturers. Based on these findings, it can be concluded that networking with suppliers benefits firms' innovativeness. Therefore, the following hypothesis is proposed:

Hypothesis 7b: There is a positive relationship between networking with suppliers and innovativeness.

Networking with Competitors: When trying to innovate, an important strategic failure that occurs is exploiting current competencies to provide short-term success, while suppressing the detection of new competencies and creating obstacles to the firm's long term viability (Levinthal and March, 1993). Many firms appear to exploit existing competencies and explore new competencies at the same time (O'Reilly and Tushman, 2004). According to Millson et al. (1996), formal and informal partnering arrangements done with other firms may help to overcome the limitations of internal resources on innovativeness. Other studies suggest that the principal benefits of networking with competitors include complementing and supplementing internal product development efforts (Rothwell and Dodgson, 1991), cost and risk sharing (Dodgson, 1994), accessing new markets and the transfer of both embedded technology and tacit knowledge (Karlsson and Olsson, 1998). Strategic alliances provide a platform for organizational learning whereby partnering firms gain access to new knowledge. In fact, managing the relationship itself is a learning process (Inkpen and Tsang, 2005; Kale and Singh, 2007; Su et al., 2009).

Despite the various advantages, concerns over intellectual property may impede firms' willingness to enter into such horizontal collaborative agreements. However, Freel (2000) argued that the most innovative firms were significantly more likely to be involved in some form of innovation-related collaborative activity with firms outside the vertical value chain. Although competitors are the most neglected stakeholders, collaboration with them revealed positive effect on innovativeness, particularly in research done in the biotechnology industry (Walker et al., 1997; Baum et al., 2000; Su et al., 2009). To this end, co-opetition strategies need to be deployed to change the perception of business from being one of win-lose to win-win (Nalebuff and Brandenburger, 1997). Therefore, we propose:

> *Hypothesis 7c: There is a positive relationship between networking with competitors and innovativeness.*

Networking with Universities: The collaboration with universities and research institutes enables small firms to develop technological knowledge which can't be accomplished alone (Bower, 1993). As in other types of external linkages, small firms are able to gain access to complicated technology and technical expertise whose direct employment is impeded by internal resource limitations (Freel, 2000). As a matter of fact, partnership with industry is on the agenda of many universities as a part of national policies to strengthen innovativeness. Consultancy provided to ventures as well as continuing education offered to professional employees by academicians (Reams, 1986; Saxenian, 1994) are examples illustrating the contributory potential of such networks. In this regard, two principal explanations are referred to. The first claims that university research is a source of significant innovation-generating knowledge which diffuses initially through personal contacts to adjacent firms (Acs et al., 1994). The second suggests that small firms are able to fill internal resource deficiencies by reaching university resource networks (Westhead and Storey, 1995).

Empirical support to the above theoretical explanations was offered by Wilkinson et al. (1996) who found in their study that 90 percent of the most innovative firms had formal links with universities. Freel (2003) also found a significant positive relationship between having university links and introducing new processes in a sample of 597 small and medium sized enterprises. Therefore, we propose:

> *Hypothesis 7d: There is a positive relationship between networking with universities and innovativeness.*

Networking with Public Agencies: The role played by public organizations in innovation has been explored by various researchers (Chung, 1999; Hassink, 2002; Heimonen, 2012). Among the valuable outcomes of networking with public organizations, specialist advice and information provided by public organizations are

crucial. Moreover, government employs the requisite expertise or has easy access to such expertise through its considerable resource networks. Alternatively, government fulfills the network management role in these collaborations. Empirically, Freel (2003) discovered the positive effect of having public sector links on product innovations. Since the regulatory environment of the public sector has an impact on small business growth and development, collaboration with public organizations has a positive effect on innovations (Freel, 2003) and breeds the skills, attitudes and values of entrepreneurs (Gibb, 1995) who need to be more innovative. Thus, we propose:

> *Hypothesis 7e: There is a positive relationship between networking with public agencies and innovativeness.*

To sum up:

> *Hypothesis 7: Networking with stakeholders such as customers, universities, suppliers, public organizations and competitors have positive relations with innovativeness.*

4 Research methodology and findings

4.1 The sample

The study was conducted in the largest Organized Industrial Site of Bursa, Turkey. The district only refers to geographical proximity of SMEs from different sectors without any support of a dedicated institution. Although the industrial site is one of the major sites in Turkey, it may not represent the whole country. Therefore, the findings are specific to the industrial site studied. SMEs comprise 99.5 percent of the total number of firms in Turkey (SIS, 2002) and are defined as the economic units having less than 250 employees and less than 25 million liras in net annual sales. Based on this definition, a total of 136 companies were identified utilizing regional websites listing SMEs and company websites. Out of 136 companies contacted, 119 agreed to participate. Out of 77 returned surveys, 74 usable (response rate = 62.18%) remained after eliminating those without entrepreneurial teams or those with missing responses.

The industries represented by SMEs in the sample are; textile (20.3%), automotive (28.4%), chemical (10.8%), information technologies (8.1%), metal/rubber/packaging (8.1%) and others (24.3%). The average age of SMEs is 18 years with a median of 14.5 years. In terms of status, 12.2% of these firms are sole proprietorships, 1.4% are open partnership, 28.4% are incorporated companies and 58.1% are limited companies.

The data is based on self-reports of either general managers or owners. Self-report surveys are indicated as the most commonly used method in studying innovation (Sonnfield et al., 2001). The single respondent approach adopted is based on the assumption that the respondents would be familiar with the information sought. Hence, it is argued that in the case of SMEs, the views of a single respondent may, in fact, reflect those of the firm (Lyon et al., 2000).

4.2 Measures of variables

The innovativeness scale used was developed by Wang and Ahmed (2004). The scale contained product, market, process, behavioral and strategic innovativeness dimensions, which as a whole measures organizational innovativeness. The instrument originally contained 20 items. However, the item "we get a lot of support from managers if we want to try new ways of doing things" was eliminated since it was not appropriate for the purpose of the research. Exemplar scale items are "In new

product and service introductions, our company is often first-to-market," "New products and services in our company often take us up against new competitors" and "We are constantly improving our business processes." Each item had a 6-point scale with the endpoints "Strongly Disagree" (= 1) and "Strongly Agree" (= 6).

The networking scale was developed by Freel (2003). A six-point Likert scale (1= strongly disagree, 2=disagree, 3= slightly disagree, 4= slightly agree, 5= agree and 6= strongly agree) was used to assess responses to the items. Networking activities were measured by asking five separate questions (Freel, 2003). An exemplar item is "Has your firm been involved in networking with customers for innovative activities during the past 3 years?" Networking with customers, suppliers, competitors, universities and public agencies for innovation-related activities were determined by forming dummy variables. Those who networked with a party for innovation related activities during the past three years were coded as "one" and coded as "zero" if otherwise.

The entrepreneurial team data was collected by asking the number of people in the founding team and the current team, followed by information on the current entrepreneurial team size. Subsequently; gender, current age, education level attained, occupation, tenure in the company and total tenure were asked. For education, six response categories were provided; i.e. elementary school (eight years), high school (11 years), two-year graduate program degree (13 years), college degree (16 years), masters' degree (18 years) and doctoral degree (22 years), and these categories were converted into continuous variables.

Team variables that were used in the analyses such as average age, average organizational tenure and average number of years of education were calculated by summing the members' values and dividing it by the number of members in the teams. For team heterogeneity variables, two different approaches were utilized. For interval data, Allison (1978) observed that the coefficient of variation provides a direct method for obtaining a scale invariant measure of dispersion. In our study, this was appropriate for interval level variables with a theoretically fixed zero point and was used for age and organizational tenure. For the categorical variable such as gender, Blau's (1977) index of heterogeneity:

$$(1- \Sigma p_i^2)$$

In the heterogeneity index, p is the proportion of group members in a category and i is the number of different categories represented in the team. Permissions from the authors of original scales and questionnaires were obtained prior to circulation. First, the questions and scales used in the questionnaire were all translated from English to Turkish. Subsequently, three managers working in the industry and an academician reviewed the translations to assure that no loss of meaning occurred.

Control Variable: Team size is seen as a factor in organizational demography theory which may affect group composition and as a result the organizational outcomes (Blau, 1977; Eisenhardt and Schhonhoven, 1990; Ancona and Caldwell, 1992). Since larger teams are likely to be more heterogeneous, they affect the coefficient of variation. Larger size also enhances cognitive diversity which enriches insights during strategy making (Bantel and Jackson, 1989; Brunning et al., 2007). Therefore, it is likely that team size is positively correlated with team heterogeneity which in turn affects innovativeness of the teams. According to Bantel and Jackson (1989), positive correlation is especially likely to exist when the teams of interest are all relatively small. Therefore, team size has been regarded as a control variable in this study.

4.3 Descriptive statistics

Of the participant firms, 20.3 percent were operating in the textile sector, 28.4 percent

were in the automotive sector, 10.8 percent were in the chemical groups sector, 8.1 percent were in information technologies sector, 8.1 percent were in the metal/rubber/packaging sector and 24.3 percent were in other businesses such as construction, printing, heating-cooling systems, logistics and consultancy. The average age of the companies was 18 years with a median of 14.5 years. 73.3 percent of the companies have employee numbers less than 50.

The entrepreneurial teams differed with regard to team formation modes. 54.1 percent were formed drawing from family members and friends. 24.3 percent of the teams utilized their professional ties prior to the firm's foundation. Only 4.1 percent of the teams were formed under the lead of an investor. These results showed that SMEs in the sample chose their entrepreneurial team members from among those with whom they have emotional kinship rather than preferring those with whom they had professional relations as was found in Westhead et al.'s (2001) study.

The entrepreneurial teams' sizes ranged from two to twelve members, with the average size being 4.04 (SD= 2.49). In total, there were 299 members in 74 teams. The majority of the 290 team members were male (male=74.8%; female=25.2%) indicating male domination. The team members were on average middle-aged (average=43.86, SD= 7.62) and had been employed by their current firms for 11.2 years on average (SD=6.73) with an average of 18.7 years of work experience (SD= 7.90). Respondents represented different functional areas such as operations/production, management, marketing/sales, finance/accounting and R&D. Educational levels attained also considerably varied; elementary school (15.2%), high school (25.9%), two-year degree (10%), college degree (37.2%), master's degree (10%) and doctoral degree (1.7%). Concerning college degree attainment, 41 percent studied technical areas (engineering or science) whereas 59% had education in non-technical fields (general business, finance/accounting, marketing/sales or law) (Table 1).

Table 1. Descriptive Statistics.

Variable	Frequency	%
Gender (N=290)		
Male	217	74.8
Female	73	25.2
Age (N=272)		
20-30	36	13.2
31-40	88	32.4
41-50	79	29.0
Above 51	69	25.4
	Mean= 43.86	**SD= 7.62**
Education (N=290)		
Elementary school	44	15.2
High school	75	25.9
Two-year degree	29	10.0
College degree	108	37.2
Master's degree	29	10.0
Doctoral degree	5	1.7
Tenure in the Company (N= 267)		
0-1 year	14	5.2
2-5 years	71	26.6
6-10 years	78	29.2
11-15 years	39	14.6

16-20 years	21	7.9
More than 21	44	16.5
	Mean=11.17	**SD= 6.73**
Tenure in General (N=248)		
0-1 year	5	2
2-5 years	19	7.7
6-10 years	46	18.5
11-15 years	43	17.3
16-20 years	37	14.9
More than 21	98	39.5
	Mean= 18.68	**SD= 7.90**

Most of the firms built networks with their customers (78.4%) and suppliers (77%), whereas networking with competitors (24.3%), universities (21.6%) and public organizations (36.5%) were relatively less frequently utilized. The means, standard deviations, reliability coefficients and inter-correlations are presented for all variables in Table 2.

4.4 Correlation analysis

Table 2 presents means, standard deviations and Pearson bivariate correlations for the twelve variables in the study, along with alpha internal reliability coefficients for multiple-item scales. The Cronbach's Alpha found for the innovativeness scale (α =0.895) exceeds the threshold of .70 suggested by Nunnally (1978). The correlation coefficients ranged between 0.012 and 0.572 (Table 2). The findings indicated that the innovativeness measures were negatively and significantly correlated with average age and age heterogeneity only at the commonly accepted level of $p< .05$. Of the six team composition variables studied, a weak positive correlation was found between innovativeness and average number of years of education ($p< 0.1$). These correlations identified are consistent with past research. Remaining team variables such as gender heterogeneity, average organizational tenure and organizational tenure heterogeneity were not correlated with innovation.

All of the networking variables were significantly correlated with innovativeness. There were positive correlations between innovativeness and networking with customers ($p< 0.01$), networking with suppliers ($p<0.01$), networking with competitors ($p< 0.05$), networking with universities ($p< 0.05$) and networking with public organizations ($p< 0.01$).

4.5 Regression analysis

The hypotheses were tested with a three-step hierarchical regression analysis, with control variable (team size), team demographics variables and networking as predictors of innovativeness. At Step 1, innovativeness was regressed on the team size. At Step 2, the team variables were added as a block to the regression model. Due to curvilinear relationships predicted, the average age was squared and the logarithm of organizational tenure was used in the analyses. At Step 3, networking variables were added, and the results are displayed on Table 3. The beta coefficients, or standardized regression coefficients, represent the strength of the unique relationship between a predictor variable and innovativeness after controlling for the effects of the other predictor variables in the regression model at that step. The R2 statistics represent the amount of variation in innovativeness that is explained by all the predictor variables in the regression model at that step.

Table 2. Means, Standard Deviations, Alpha Coefficients and Intercorrelations for Variables.

Variables	$\overline{X}$	Σ	α	1	2	3	4	5	6	7	8	9	10	11	12
1. Organizational Innovativeness	4.25	0.82	0.895												
2. Gender Heterogeneity	0.25	0.23	n.a.	0.103											
3. Average Age	43.86	7.62	n.a.	-0.268*	0.059										
4. Age Heterogeneity	0.19	0.12	n.a.	-0.270*	-0.179	0.098									
5. Average Organizational Tenure	11.17	6.73	n.a.	-0.060	0.236*	0.524**	0.046								
6. Organizational Tenure Heterogeneity	0.30	0.34	n.a.	0.027	0.012	-0.058	0.341**	0.272*							
7. Average Number of Years of Education	13.38	2.92	n.a.	0.224[a]	0.019	-0.172	0.066	0.033	0.188						
8. Networking with Customers	0.78	0.41	n.a.	0.389**	0.177	-0.213[a]	-0.133	0.029	-0.112	0.373**					
9. Networking with Suppliers	0.77	0.42	n.a.	0.408**	-0.003	-0.080	-0.057	-0.012	-0.145	0.308**	0.572**				
10. Networking with Competitors	0.24	0.43	n.a.	0.285*	0.131	-0.115	-0.160	0.057	-0.128	0.087	0.298**	0.310**			
11. Networking with Universities	0.22	0.41	n.a.	0.269*	-0.020	-0.092	0.085	-0.037	-0.003	0.348**	0.116	0.287*	0.161		
12. Networking with Public Organizations	0.36	0.48	n.a.	0.404**	0.117	-0.221[a]	-0.094	-0.119	-0.003	0.205a	-0.011	0.147	-0.168	0.147	
13. Team Size	4.04	2.49	n.a.	0.285*	0.107	-0.056	0.066	0.037	0.355**	0.068	0.102	-0.108	0.003	-0.035	0.124

[a] $p < 0.1$; * $p < 0.05$; ** $p < 0.01$

At Step 1, the control variable 'team size' explained a significant ($p < .05$) amount of the variation in innovativeness. Size as a control variable maintained its significance in subsequent steps. At Step 2, the addition of the team demographics variables brought a significant ($p < .05$) increase in the amount of variation explained in innovativeness beyond that explained by the control variable. Age heterogeneity had a negative ($p < .05$) and average years of education ($p < .10$) had a unique positive relationship with innovativeness. Thereby, support for the third and the sixth hypotheses was obtained in the absence of networking variables. At Step 3, adding remaining networking variables again increased the amount of variation explained significantly ($p < 0.001$) beyond that was explained by both control variables and entrepreneurial team characteristics. Only age heterogeneity remained having a significant effect on innovativeness ($p < .05$), thus supporting our third hypothesis. The findings failed to support proposed positive relationships between innovativeness and gender heterogeneity, average age, average tenure, tenure heterogeneity, and education heterogeneity.

Table 3. Hierarchical Regression Analysis.

	Organizational Innovativeness Beta Values		
Predictor Variables	**Step 1**	**Step 2**	**Step 3**
Control Variable			
Team Size	0.285*	0.282*	0.229*
Team Variables			
Gender Heterogeneity		0.029	-0.049
Average Age (Squared)		-0.219	-0.051
Age Heterogeneity		-0.265*	-0.240*
Average Organizational Tenure (Log)		0.023	-0.033
Organizational Tenure Heterogeneity		-0.043	0.126
Average Number of Years of Education		0.186[a]	-0.082
Networking Variables			
Networking with Customers			0.195
Networking with Suppliers			0.193
Networking with Competitors			0.185[a]
Networking with Universities			0.161
Networking with Public Organizations			0.340**
Adjusted R^2	0.069	0.177	0.420
R^2	0.081	0.256	0.516
ΔR^2		0.174	0.260
F	6.377*	3.237**	5.414***
ΔF		2.574*	6.555***

[a] p< 0.1; * p< 0.05; ** p< 0.01; *** p< 0.001

The analysis revealed that networking with public organizations had a significant positive effect on innovativeness ($p< 0.01$) along with a slight positive impact created by networking with competitors ($p< 0.1$), thus validating hypotheses 7c and 7e. However, the results failed to support significant positive relationships expected between innovativeness and networking done with customers, universities, and suppliers (Hypotheses 7a, 7b, 7d). Adding networking variables to the regression equation increased explanatory capacity of the model, reflected in a change in the value of R^2 by .260.

We examined the variance inflation factors (VIFs) for the predictor variables in the full regression model that included control variables as well as team and networking variables. This aimed to assess whether multicollinearity was a serious problem in the regression analysis. As defined, multicollinearity implies how much a given predictor variable correlates with the set of other predictor variables in the regression model. Multicollinearity decreases the likelihood of obtaining statistically significant coefficients by increasing the standard error of the regression coefficient for the predictor variable. The examination of the resulting VIF indices indicated that all values are 2.04 or less; a value below the threshold of ten that is generally used as the

evidence of serious multicollinearity, suggesting that multicollinearity is not a serious problem (Ryan, 1997; Ryan, 2003; Cohen et al., 2003).

5 Discussion and policy implications

Overall, our results suggest that entrepreneurial team characteristics and networking are antecedents of innovativeness capability in small firms after controlling for the effect of size of the entrepreneurial teams. The significant effect of entrepreneurial team size on innovativeness found in Step 1 indicates the importance of optimizing the processes of coordination within the teams in enhancing innovative capability of SMEs.

The significant evidence obtained concerning impact of entrepreneurial team characteristics on innovativeness (Step 2) primarily reveals that increase in age heterogeneity influences innovativeness adversely. This finding is consistent with previous research which argued that increasing age differences bred potential for conflict (Hartel, 2004), which subsequently decreased consensus and cooperation over strategic targets such as enhancement of innovativeness capability. The moderate positive effect of educational backgrounds of team members on innovativeness at this step manifests the value of entrepreneurship training to be provided by universities and other institutions that would eliminate the educational gap.

Concerning networking, respondents admitted that they relied on external sources in order to innovate. However, despite the arguments on the gains of networking with multiple parties (Tsai and Ghoshal, 1998), networking with public institutions was the major contributing variable to small business innovation for the sample. In a sense, this indicates the possibility of redundant relations with other actors. In fact, public policies on protection of intellectual property and public funding allocated, particularly to R&D activities, were found to be critical in enhancing SME innovativeness (Heimonen, 2012). Hence, similar public policies need to be developed and communicated with the aim of furthering SME utilization. In addition, the moderate effect of networking with competitors on innovativeness indicates that novel ideas can be created by either exchanging or combining resources with them. Networking with competitor firms may facilitate pooling of competencies whereby high-quality information and tacit knowledge compiled may trigger firms' innovativeness capacity.

Although firms in the sample more frequently established networks with customers (78.4%) and suppliers (77%), and less with public organizations (36.5%) and competitors (24.3%), our findings validated significant contributions to innovativeness by the latter two only. Various explanations may lie behind the reluctance in utilizing more beneficial networks. This can be partly attributed to the unawareness of entrepreneurial teams of the potential of networking, particularly with public organizations. Inefficiencies due to bureaucracy in reaping the benefits of this opportunity may be another likely cause. On the other end, public organizations may fail to tailor SME programs to the specific needs of small firms. Plus, public organizations' failure in delegating centrally administered power to their local representatives which carry out local relations with SMEs may bring an alternative explanation for the negligence.

When the findings of all steps were considered, it was interesting to see that the positive significant effect of education found in Step 2 disappeared in the next step where networking variables were added into the regression analysis. Added to this is the change in the direction of relationship between Step 2 and 3 for average organizational tenure and both tenure and gender heterogeneity. The interaction effect implications are interesting and may be explored further by future research.

The literature on top management teams led to inconclusive findings concerning team heterogeneity's effect on strategic change (Hambrick and Mason, 1984; Wiersema and Bantel, 1992). The hypothesized relationship of heterogeneity and innovativeness which also entails a strategic move is not completely supported with our findings. The only significant enduring effect in our analysis is that of age heterogeneity which can be classified as a non-job-related heterogeneity. The criticisms with regard to predictive power of team heterogeneity are therefore partly supported by this study. However, the most striking is our finding on possible substitution of the impact created by teams' average educational level with that of networking with public organizations in enhancing innovativeness. As networking with public agencies was introduced in the regression equation in Step 3, the impact of education was offset by their effect. This implies that entrepreneurial teams may balance their educational shortcomings with networks established with public agencies.

The findings, in a way, replicate past arguments (Buğra, 2007) stating that the Turkish private sector owed their existence to the state. Buğra particularly implied that state subsidy policies created a protective climate against foreign competition for decades and kept many firms afloat which otherwise could not survive. Under the influence of past tradition, entrepreneurial teams in the sample viewed their organizational innovativeness mostly dependent on networking with public organizations. Moreover, the substitutability of human capital (average number of years of education) with networking (with public organizations) is a novel finding which may bring new insights in developing innovativeness capacity given the scarcity of talented human resources. Relatively higher contributions on innovativeness made by networking with external stakeholders against self-sufficiency may help public organizations develop a new array of policies. Communicating innovativeness enhancement policies of public agencies directly to SMEs or by way of agents is yet another important issue to be considered.

Moreover, entrepreneurial teams should acknowledge the enormous potential of networking with stakeholders such as suppliers, competitors, customers and universities in enhancing their innovativeness. In order to make plural-actor networking more viable, SMEs need to be provided tools for partnership development and stakeholder engagement. Training programs covering these issues will enhance their networking skills. On the other hand, universities need to review their policies if they are to attract SMEs' attention for collaboration on innovativeness focused projects. Networking with competitors necessitates the existence of a trusting business environment. Therefore, enhancing intellectual property laws and creating an environment of just relations will be crucial towards this end.

6 Limitations of the study and suggestions for future research

Finally, it is important to highlight the various limitations of the research. First, the data is collected from Bursa region which may have its own idiosyncratic features. A potential for bias lies in our focus on a single industrial site which prevents us generalizing our findings to the whole country. Second, the networks in this research are not studied distinguishing weak and strong natures of ties. The flow of knowledge along different types of networks will obviously vary and lead to different outcomes. The development of a full model considering different featured ties provides important opportunity for future researchers. In line with this perspective, studying characteristics of the industrial sites such as proximity or geographic space, which may affect how social networks are shaped, may be worthwhile. Distinguishing different stages in networking may also be of interest to future researchers. Third,

availability of entrepreneurial human and social capital does not adequately clarify how innovation may take place. These types of capital do not adequately explain the effect of cognitive and organizational factors. Therefore, future research may be carried out focusing on different aspects of innovation processes. A focus in issues like changing absorptive capacity of teams would be rewarding in developing a more holistic view of innovativeness. Moreover, networking with public agencies may be further detailed to distinguish local, national, as well as semi-governmental agencies, available in the country. Availability of local institutions (either public or private) in the district acting as a data bank where information is pooled would be an important factor in providing the needed support. Lastly, comparing different structures such as new start-ups in incubators, established firms and high-tech firms may lead to valuable contributions. To conclude, the results presented here are pioneering in that they show the first direct effects of entrepreneurial teams and networking on innovativeness capacity in a sample of SMEs in Bursa, Turkey.

Note: A previous version of this paper has been presented at 2010 SBI Annual Conference, Albuquerque. The authors convey their thanks to the two anonymous reviewers for their invaluable contributions.

7 References

Acs, Z., FitzRoy, F., & Smith, I. (1994). High-technology Employment and University R&D Spillovers: Evidence from US Cities. *Occasional paper no. 50, CIBER*, University of Maryland.

Ahuja, G. (2000). The duality of collaboration: Inducements of opportunities in the formation of interfirm linkages. *Strategic Management Journal, 21,* 317-343.

Allison, P.D. (1978). Measures of inequality. American Sociological Review, 43, 865-880.

Ancona, D.G., & Caldwell, D.F. (1992). Bridging the boundary: External activity in performance in organizational teams. *Administrative Science Quarterly, 37*, 634-665.

Bantel, K. & Jackson, S. (1989). Top management and innovation in banking: Does the composition of the top team make a difference? *Strategic Management Journal, 10*, 107-124.

Barney, J. (2001). Resource-based theories of competitive advantage: A ten-year retrospective in the resource-based view. *Journal of Management, 27*(6), 643-650.

Bantel, K., & Jackson, S. (1989). Top management and innovation in banking: Does the composition of the top team make a difference? *Strategic Management Journal, 10*, 107-124.

Baum, J. A. C., Calabrese, T., & Silverman, B. S. (2000). Don't go it alone: Alliance network composition and start-ups' performance in Canadian biotechnology. *Strategic Management Journal, 21*(3), 267-294.

Bell, G. G. (2005). Clusters, networks and firm innovativeness. *Strategic Management Journal, 26*, 287-295.

Blau, P.M. (1977). *Inequality and Heterogeneity*. New York: The Free Press.

Botwinick, J. (1977). *Aging and Behavior*. Springer, New York.

Bower, D. J. (1993). Successful joint ventures in science parks. *Long Range Planning, 26*(6), 114–120.

Brunetto, Y., & Far-Wharton, R. (2007). The moderating role of trust in sme owner/managers decision making about collaboration. *Journal of Small Business Management, 45*(3), 362-387.

Brunning, O., Nordqvist, M., & Wiklund, J. (2007). Corporate governance and strategic change in SMEs: The effects of ownership, board composition and top management teams. *Small Business Economics, 29*, 295-308.

Buğra, A. (2007). *Devlet ve İşadamları*. İletişim Yayınları, 5th edition.

Burke, D.M., & Leah, L.L. (1981). Memory and aging: The role of retrieval processes. *Psychological Bulletin, 90*, 513-546.

Camelo-Ordaz, C., Hernandez-Lara, A. B., & Valle-Cabrera, R. (2005). The relationship between top management teams and innovative capacity in companies. *Journal of Management Development, 24*(8), 683-705.

Cannella, A.A., Pettigrew, A., & Hambrick, D. (2001). Upper echelons: Donald Hambrick on executives and strategy. *The Academy of Management Executive, 15*(3), 36-42.

Carlsson, G., & Karlsson, K. (1970). Age, cohorts and regeneration of generations. *American Sociological Review, 35*, 710-718.

Carpenter, M. A. (2002). The implications of strategy and social context for the relationship between top management team heterogeneity and firm performance. *Strategic Management Journal, 23*, 275-284.

Carpenter, M.A., Geletkanycz, M.A. & Sanders, W.G. (2004). Upper echelons research revisited: Antecedents, elements, and consequences of top management team composition. *Journal of Management, 30*(6), 749-778.

Child, J. (1974). Managerial and organizational factors associated with company performance. *Journal of Management Studies, 11*, 13-27.

Chung, S. (1999). Korean innovation policies for SMEs. *Science and Public Policy, 26*, 70– 82.

Cohen, J., Cohen, P., West, S. G., & Aiken, L. S. (2003). *Applied Multiple Regression /Correlation Analysis for the Behavioral Sciences*. 3rd edition, NJ: Erlbaum: Mahwah.

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

Cooper, A.C., & Bruno, A. (1977). Success among high technology firms. Business Horizons, 20(2), 16–22.

Dakhli, M., & De Clercq, D. (2004). Human capital, social capital and innovation: A multicountry study. Entrepreneurship and Regional Development, 16, 107-128.

Daellenbach, U. S., McCarthy, A. M., & Schoenecker, T. S. (1999). Commitment to innovation: The impact of top management characteristics. R&D Management, 29(3), 199-208.

Damanpour, F. (1991). Organizational innovation: A meta-analysis of effects of determinants and moderators. *Academy of Management Journal, 34*, 555-590.

Davidsson, P., & Honig, B. (2003). The role of social and human capital among nascent entrepreneurs. *Journal of Business Venturing, 18*(3), 301-331.

Deshpande, R., & Farley, J. U. (1999). Executive insights: Corporate culture and market orientation: Comparing Indian and Japanese firms. *Journal of International Marketing, 7*(4), 111-127.

Deshpande, R., & Farley, J. U. (2000). Market-focused organizational transformation in China: Global marketing in Great China. *Journal of Global Marketing, 14*, 7-35.

Dodgson, M. (1994). Technological Collaboration and Innovation. In Dodgson, M. and R. Rothwell (Ed.), *The Handbook of Industrial Innovation*. (pp.285-292). Cheltenham: Edward Elgar.

Downs, G., & Mohr, L.(1976). Conceptual issues in the study of innovation. *Administrative Science Quarterly, 21*, 700-714.

Eisenhardt, K., & Schoonhoven, C. B. (1990). Organizational growth: Liking founding team, strategy, environment and growth among U.S. semiconductor ventures. *Administrative Science Quarterly, 3*, 504-529.

Elfring, T. & Hulsink, W. (2007). Networking by entrepreneurs: Patterns of tie-formation among emerging organizations. *Organization Studies, 28*(12), 1849-1872.

Freel, M. (2000). External linkages and product innovation in small manufacturing firms. *Entrepreneurship and Regional Development, 12*, 245-266.

Freel, M. (2003). Sectoral patterns of small firm innovation, networking and proximity. *Research Policy, 32*, 751-770.

Gibb, A. (1995). Learning skills for all: The key to success in small business development. In ICSB Annual Conference Proceedings (pp. 1-21).

Glass, A. (2007). Understanding Generational Differences for Competitive Success. *Industrial and Commercial Training, 39*(2), 98-103.

Greve, A., & Salaff, J. V. (2003). Social networks and entrepreneurship. *Entrepreneurship Theory and Practice, 28*(1), 1-22.

Griffin, A. (2002). Product development cycle time for business to business products. *Industrial Marketing Management, 31*(4), 291–304.

Hakansson, H., & Snehota, I.(1990). *No business is an island: The network concept of business strategy*. In D. Ford (Ed.), Understanding Business Markets (pp.526-540). London: Academic Press.

Hambrick, D. C., & Mason, P. A.(1984). Upper Echelons: The Organization as a Reflection of Its Top Managers. *Academy of Management Review, 9*, 193-206.

Hartel, C. E. (2004). Towards a multicultural world: Identifying work systems, practices and employee attitudes that embrace diversity. *Australian Journal of Management, 29*(2), 189-200.

Hayes, R., & Abernathy, W. (1980). Managing our way to economic decline. *Harvard Business Review, 57*(4), 11-25.

Hassink, R. (2002). Regional innovation support systems: Recent trends in Germany and East Asia. *European Planning Studies, 10*(2), 153-164.

Heimonen, T. (2012). What are the factors that affect innovation in growing SMEs? *European Journal of Innovation Management, 15*(1), 122-144.

Hendry, C., Arthur, M., & Jones, A. (1995). *Strategy Through People*. London: Routlege.

Hoffman, L. R., & N. R. F. Maier (1961). Quality and acceptance of problem solutions by members of homogeneous and heterogeneous groups. *Journal of Abnormal and Social Psychology, 62,* 401-407.

Inkpen, A. C., & Tsang, E. W. K. (2005). Social capital, networks and knowledge transfer. *Academy of Management Review, 30*(1), 146-165.

Jack, S. (2005). The role, use and activation of the strong and weak network ties: A qualitative analysis. *Journal of Management Studies, 42*(6), 1233-1259.

Kale, P., & Singh, H. (2007). Building firm capabilities through learning: The role of alliance learning process in alliance capability and firm-level alliance success.

Strategic Management Journal, 28(10), 981-1000.

Karlsson, C., & Olsson, O. (1998). Product innovation in small and large enterprises. *Small Business Economics, 10*, 31-46.

Katz, R. (1982). The effects of group longevity on project communication and performance. *Administrative Science Quarterly, 27*, 81-104.

Kimberly, J.R., & Evanisko, M.J. (1981). Organizational innovation: The influence of individual, organizational, and contextual factors on hospital adoption of technological and administrative innovations. *Academy of Management Journal, 24*, 689-713.

Kitchell, S. (1997). CEO characteristics and technological innovativeness: A Canadian perspective. *Canadian Journal of Administrative Sciences, 14*(2), 111-125.

Leonard, D., & Sensiper, S. (1998). The role of tacit knowledge in group innovation. *California Management Review, 40*(3), 112-132.

Levinthal, D. A., & March, J.G. (1993). The myopia of learning. *Strategic Management Journal, 14*, 95-112.

Li, C.R. (2012). How top management team diversity fosters organizational ambidexterity: The role of social capital among top executives. *Journal of Organization Change Management, 26*(5), 874-896.

Ling, Y. & Kellermanns, F. W. (2010). The effects of family firm specific sources of TMT diversity: The moderating role of information exchange frequency. *Journal of Management Studies, 47*(2), 322-344.

Lyon, D., Lumpkin, G., & Dess, G. (2000). Enhancing entrepreneurial orientation research: Operationalizing and measuring a key strategic decision-making process. *Journal of Management, 26*(5), 1055-1085.

Massa, S., & Tessa, S. (2008). Innovation and SMEs: Misaligned perspectives and goals among entrepreneurs, academics, and policy makers. *Technovation,* 393-407.

Millson, M. R., Raj, S. P., & Wilemon, D. (1996). Strategic Partnering for Developing New Products. *Research Technology Management, 39*(3), 41-49.

Molina-Moralez, F. X., & Martinez-Fernandez, M. T. (2010). Social networks: Effect of social capital on firm innovation. *Journal of Small Business Management, 48*(2), 258-279.

Nahaipet, J. & Ghoshal, S. (1998). Social capital, intellectual capital and the organizational advantage. *Academy of Management Review, 23*(42), 242-266.

Nalebuff, B.J., & Brandenburger, A. M. (1997). Co-opetition: Competitive and cooperative business strategies for the digital economy. *Strategy & Leadership, 25*(6), 28 – 35.

Naranjo-Gil, D., Hartmann, F., & Maas, V. S. (2012). Top management team heterogeneity, strategic change and operational performance. *British Journal of Management, 19,* 222-234.

Noteboom, B. (1994). Innovation and diffusion in small firms: Theory and evidence. *Small Business Economics, 6*(5), 327-347.

North, D., & Smallbone, D. (2000). Innovative activity in SMEs and rural economic development: Some evidence from England. *European Planning Studies, 8*(1), 87-106.

Nunnally, J. C. (1978). Psychometric Theory. McGraw Hill Book Company, New York.

O'Reilly, C., & Tushman, M. L. (2004). The ambidextrous organization. *Harvard*

Business Review, 82(4), 74-81.

Peteraf, M. A. (1993). The cornerstones of competitive advantage: A resource-based view. *Strategic Management Journal, 14*(3), 179-191.

Pirolo, L., & Presutti, M. (2010). The impact of social capital on the start-ups' performance growth. *Journal of Small Business Management, 48*(2), 198-227.

Prahalad, C.K., & Ramaswamy, V. (2004). Co-creating unique value with customers. *Strategy and Leadership, 32*(3), 4-9.

Reams, R. (1986). University–Industry Research Partnerships. Quorum: Westport, CT.

Ramcharran, H. (2001). Inter-firm linkage and profitability in the automobile industry: The implications for supply chain management. *The Journal of Supply Chain Management, 37*(1), 11-17.

Rothwell, R. (1991). External networking and innovation in small and medium size manufacturing firms in Europe. *Technovation, 11*(2), 93-112.

Rothwell, R., & Dodgson, M. (1991). External linkages and innovation in small and medium-sized enterprises. *R&D Management, 21*, 125-137.

Rothwell, R., & Gardiner, P. (1985). Invention, innovation, re-innovation and the role of the user: A case study of British hovercraft development. *Technovation, 3*, 167-186.

Ryan, T. P. (1997). *Modern Regression Methods*. John Wiley and Sons, New York.

Ryan, T. P. (2003). *Modern Regression Methods*. New York: John Wiley and Sons.

Saxenian, A. (1994). *Regional Advantage*. Harvard University Press: Cambridge, MA.

Seghers, A., Manigart, S., & Vanacker, T. (2012). The impact of human and social capital on entrepreneurs' knowledge of finance alternatives. *Journal of Small Business Management, 50*(1), 63-86.

Sethi, R., Smith, D. C., & Park, C. (2002). How to kill a team's creativity. *Harvard Business Review, 80*(8), 73-86.

Shrader, R., & Siegel, D. S. (2007). Assessing the relationship between human capital and firm performance: Evidence from technology-based new ventures. *Entrepreneurship Theory and Practice, 31*(6), 893-908.

SIS (2002). Genel Sanayi İşyerleri Sayımı, Ankara, Turkey: Turkish State Institute of Statistics.

Sonfield, M., Lussier, R., Corman, J., & McKinney, M. (2001). Gender comparison in decision making: An empirical analysis of the entrepreneurial strategy matrix. *Journal of Small Business Management, 39* (2), 165–173.

Spence, L.J., Schmitpeter, R., & Habisch, A. (2003). Assessing social capital: Small and medium-sized enterprises in Germany and U.K.. *Journal of Business Ethics, 47*(1), 17-29.

Su, Y. S., Tsang, E. W. K., & Peng, M. W. (2009). How do internal capabilities and external partnerships affect innovativeness? *Asian Pacific Journal of Management, 26*, 309-331.

Taqi, A. (2002). Older people, work and equal opportunity. *International Social Security Review, 55*(1), 107-120.

Thomke, S., & Von Hippel, E. (2001). Customers as innovators: A new way to create value. *Harvard Business Review, 80*(4), 74-81.

Tidd, J., Bessant, J., & Pavitt, K. (1997). *Managing Innovation: Integrating Technological, Market and Organizational Change*. West Sussex: John Wiley &

Sons.

Tsai, W. (2000). Knowledge transfer in intraorganizational networks: Effect of network position and absorptive capacity on business unit innovation and performance. *Academy of Management Journal, 44*(5), 996-1004.

Tsai, W., & Ghoshal, S. (1998). Social capital and value creation: The role of intrafirm networks. *Academy of Management Journal, 41*(4), 464–478.

Turnbull, P., Oliver, N., & Wilkinson, B. (1992). Buyer-supplier relations in the UK automotive industry: Strategic implications of the Japanese manufacturing model. *Strategic Management Journal, 13*, 159-168.

Üçbaşaran, D., Lockett, A., Wright, M., & Westhead, P. (2003). Entrepreneurial founder teams: Factors associated with team member entry and exit. *Entrepreneurship Theory and Practice, 28*(3), 107–128.

Varis, M., & Littunen, H. (2010). Types of information, sources of innovation and performance in entrepreneurial SMEs. *European Journal of Innovation Management, 13*(2), 128-154.

Von Hippel, E., & Katz, R. (2002). Shifting innovation to users via toolkits. *Management Science, 48*(7), 821-833.

Vroom, V., & Pahl, B.(1971). Relationship between age and risk-taking among managers. *Journal of Applied Psychology, 55*, 399-405.

Walker, G., Kogut, B., & Shan, W. J. (1997). Social capital, structure holes, and the formation of an industry network. *Organization Science, 8*(2), 109–125.

Wang, C. L., & Ahmed, P. K. (2004). The development and validation of the organizational innovativeness construct using confirmatory factor analysis. *European Journal of Innovation Management, 7*(4), 303-313.

West, M.A., & Farr, J. L. (1990). *Innovation and Creativity at Work: Psychological and Organizational Strategies*. New York: Wiley.

Westhead, P., Cowling, M., & Howorth, C. (2001). The development of family companies: Management and ownership imperatives. *Family Business Review, 14*(4), 369-385.

Westhead, P., & Storey, D. (1995). Links between higher education institutions and high technology firms. *Omega, 23*, 345-360.

Wicklund, J., & Shephard, D. (2003). Knowledge-based resources, entrepreneurial orientation, and the performance of small and medium sized businesses. *Strategic Management Journal, 24,* 1307-1314.

Wiersema, M. F., & Bantel, K.A. (1992). Top management team demography and corporate strategic change. *Academy of Management Journal, 35*, 91-121.

Wilkinson, F., Lawson, C, Keeble, D., Lawton-Smith, H., & Moore, B. (1996). Innovative behaviour of technology-based SMEs. Paper presented at the joint CBR/Warwick SME Centre conference. University of Cambridge, Cambridge.

Wood, W. (1987). Meta-analytic review of sex differences in group performance. *Psychological Bulletin, 102*, 53.

Zaheer, A., & Bell, G. G. (2005). Benefits from network position: firm capabilities, structural holes and performance. *Strategic Management Journal, 26*, 809-825.

Zaidi, S. M. A., Saif, M. I., & Zaheer, A. (2010). The effect of workgroup heterogeneity on decision making: An empirical investigation. *African Journal of Business Management, 4*(10), 2132-2139.

A Quantitative Model for Decomposing & Assessing the Value for the Customer

Susana Nicola[1], Eduarda Pinto Ferreira[1], J. J. Pinto Ferreira[2]

[1] Instituto Superior de Engenharia do Porto, Instituto Politécnico do Porto, GECAD, Porto, Portugal

{sca, epf}@isep.ipp.pt

[2] Universidade do Porto, Faculdade de Engenharia/DEIG, INESC TEC / UITT, Porto, Portugal

jjpf@fe.up.pt

Abstract. The research presented in this paper proposes a novel quantitative model for decomposing and assessing the Value for the Customer. The proposed approach builds on the different dimensions of the Value Network analysis proposed by Verna Allee having as background the concept of Value for the Customer proposed by Woodall. In this context, the Value for the Customer is modelled as a relationship established between the exchanged deliverables and a combination of tangible and intangible assets projected into their endogenous or exogenous dimensions. The Value Network Analysis of the deliverables exchange enables an in-depth understanding of this frontier and the implicit modelling of co-creation scenarios. The proposed Conceptual Model for Decomposing Value for the Customer combines several concepts: from the marketing area we have the concept of Value for the Customer; from the area of intellectual capital the concept of Value Network Analysis; from the collaborative networks area we have the perspective of the enterprise life cycle and the endogenous and exogenous perspectives; at last, the proposed model is supported by a mathematical formal description that stems from the area of Multi-Criteria Decision Making. The whole concept is illustrated in the context of a case study of an enterprise in the footwear industry (Pontechem). The merits of this approach seem evident from the contact with Pontechem as it provides a structured approach for the enterprises to assess the adequacy of their value proposition to the client/customer needs and how these relate to their endogenous and/or exogenous tangible or intangible assets. The proposed model, as a tool, may therefore be a useful instrument in supporting the commercialisation of new products and/or services.

Keywords: Value for the Customer, Value Proposition, Asset Management, Fuzzy AHP.

1 Introduction

Delivering and creating value for the customers is the foundation of any business enterprise, in fact, value has been “the fundamental basis for all marketing activity” (Holbrook, 1994). The Marketing Science Institute (MSI) (Institute., 2010) included in its list of the research priorities, the development of marketing capabilities for a customer focused organization - “research is required to develop ways to identify, develop, and deliver compelling value propositions that incorporate customers as collaborators”. For the majority of current Industrial Marketing research concerned with value creation, the focus is on Value for the Customer. The reasoning behind such concentration is, according to MSI, the “need to get better sense of what is on their minds” and the “need to know the construction of insights into why people buy and used products or services”.

ISSN 2183-0606
http://www.open-jim.org

Knowledge about customer's perceived value and "knowledge used to anticipate what customer will value in the future play central roles in building and maintaining a sustainable advantage" (Blocker and Flint, 2007). To this end, the challenge in many enterprises is to "develop an offering that is both flexible and capable of being tailored to fit the specific requirements of customers" (Rahikka et al., 2011). This is what the value proposition is about. The value proposition often displays in practice a one-sided enterprise perspective (Woodruff and Flint, 2006). However, the Value Proposition (VP) "is an overall view of a company's bundle of products and services that are of value to the customer." (Osterwalder, 2004). It is also a fact that customers do not perceive the enterprise offers to be equally important from their own point of view. As some authors say, "the value proposition defines the specific strategy to compete for new customers" (Jalili and Rezaie, 2010). So it is essential to determine which factors determine the perception on Value for the Customer (VC) and how this value is perceived, involving what the customer receives (e.g. benefits) and what he gives up to acquire and use a product (e.g.: costs and sacrifices), (Flint et al., 2002, Lapierre, 2001, Ulaga, 2003, Komulainen et al., 2007). Following that line of thinking it is required to have a clear knowledge of the nature of the interactions between enterprise members, customers, and suppliers (Kowalkowski, 2011).

With these issues in mind, the research presented in this paper proposes a novel quantitative model for decomposing and assessing the Value for the Customer. The proposed approach builds on the different dimensions of the Value Network analysis proposed by Verna Allee (Allee, 2008a) having as background the concept of Value for the Customer proposed by Tony Woodall (Woodall, 2003). In this context, the Value for the Customer is modelled as a relationship established between the exchanged deliverables and a combination of tangible and intangible assets projected into their endogenous or exogenous dimensions. The Value Network Analysis of the deliverables exchange, enables an in-depth understanding of this frontier and the implicit modelling of co-creation scenarios. The proposed Conceptual Model for Decomposing Value for the Customer combines several concepts: from the marketing area we have the concept of Value for the Customer; from the area of intellectual capital the concept of Value Network Analysis; from the collaborative networks area we have the perspective of the enterprise life cycle and the endogenous and exogenous perspectives; at last, the proposed model is supported by a mathematical formal description that stems from the area of Multi-Criteria Decision Making. In this context, the contribution of this research to the body of knowledge may be structured along the following dimensions: 1) a novel Conceptual Model for Decomposing Value for the Customer listing the relationships between the different components of the model; 2) an approach for using the Conceptual Model by reducing the burden tasks demanded from the enterprise customer; 3) a method for assessing and integrating of both the enterprise and the customer perspectives of the perceived value; 4) the supporting of Fuzzy AHP (Chen, 2004b, Ertuğrul and Karakaşoğlu, 2008, Nukala and Gupta, 2005) quantitative formulation for this multi-criteria decision making problem; at last, 5), the actual computational implementation of the quantitative model that was developed using PHP and a MySQL database.

The proposed model is presented in the forthcoming chapters and finally discussed in the context of a case study in the footwear industry in Portugal (APICCAPS, 2008). The next paragraph introduces the literature review on the concept of the Value for the Customer. Then, the three steps of the proposed method to assess and decompose the Value for the Customer are presented, followed by the research questions and an overview of the research methodology. The framework for describing and analyzing the value creation in the context of a case study is then presented. At last are discussed the managerial implications, the limitations of the study, the future research and the final conclusions are presented.

2 Value for the Customer

The concept of customer value is one of the most overused concepts in the literature and several definitions of customer value as perceived and defined by the customer have been offered, such as: "customer value" (Woodruff, 1997b, Anderson et al., 2006); "consumer value" (Lai, 1995); "customer perceived value" (Lapierre, 2000); "value for the customer" (Woodall, 2003). Woodall (2003), proposed a definition of these related customer concept of value, by choosing the term Value for the Customer (VC):

> *"Value for the customer (VC) is any demand-side, personal perception of advantage arising out of a customer's association with an organisation's offering, and can occur as reduction in sacrifice; presence of benefit (perceived as either attributes or outcomes); the resultant of any weighed combination of sacrifice and benefit; or an aggregation, over time, of any or all these", (Woodall, 2003 p.2)*

Over many years much work has been made and discussed in the literature on the concept on Value for the Customer. Zeithmal has suggested customer perceived value as "what they get benefits relative to what they have to give up" (cost or sacrifices) (Zeithaml, 1988). Lay has suggested a framework for customer value focuses on the buyer's evaluation of product purchase at the time of buying, integrating cultural value, personal values, consumption values and product benefits (Lai, 1995). Huber believed that benefits and costs are defined in terms of consumer's perceptions in the activities of acquisition, consumption and maintenance (Huber et al., 1997). Flint creates a model to describe how customers' perceptions of value change over time in industrial supply relationship. This model focuses in three forms of value: values, desired value and value judgment (Flint et al., 1997). Woodruff defines customer value as "a customer's perceived preference for and evaluation of those product attributes, attribute performances and consequences arising from use that facilitate achieving the customer's goals and purposes in use situations" (Woodruff, 1997). This author develops a model to customer value oriented marketing information system (CVOMIS). In industrial context, Lapierre develop a scale to measure customer perceived value: called the "key drivers" - benefits and sacrifices (Lapierre, 2000). Also emphasized that customer perceived value can be defined as the "difference between the benefits and sacrifices perceived by the customers in response to their expectations, that is their needs and wants" (Lapierre, 2001). Simpson created a framework for supplier market-orientation, where market orientated behaviours are conceptualized (Simpson et al., 2001). The authors (Kothandaraman and Wilson, 2001) had developed a model based on three concepts of value creation: superior customer value, core capabilities and relationship. Woodall has developed a framework for Value for the a longitudinal perspective and different forms of value, (Woodall, 2003). Ulaga developed a model for buyer-seller relationship and integrate the relationship value into the network relationship marketing, (Ulaga and Eggert, 2006). Smith and Colgate adopt the term customer value and define this term "as a summative or ratio based evaluation or whether it is made with compensatory or non-compensatory rules". These authors had presented a conceptual framework for marketers incorporating four major types of value that can be created by the organization and five major sources value (Smith and Colgate, 2007).

Two theories have been developed by Vargo & Lusch (2004) and by Gönroos (2008) to assess exchange. They combine the value-in-exchange and value-in-use based on the service perspective. The "service logic" within marketing identified by (Grönroos, 2008) makes explicit the value creation that emerges from the interaction between enterprise and customer. This theory has a two-sided perspective. On the

firms role we have the value creation process, and sometimes under certain circumstances the enterprise has the opportunity to create value together with the customer that becomes a co-creator of value. In the "service dominant logic" identified by (Vargo and Lusch, 2004), the service is the fundamental base of exchange. This point of view is based on the definition of service "the process of using one's competences (knowledge and skills) for the benefits of the other party" (Vargo and Lusch, 2004 p374). These authors viewed the customer's as co-creators of value:

> *"the value creation is always a collaborative and interactive process that takes place in the context of a unique set of multiple exchange relationship, when service is provided though goods"* (Vargo and Lusch, 2004 p372).

"The determination of value in the process of exchange remains an important component of value creation" (Kowalkowski, 2011). In order to understand the enterprise capability to create value one should go beyond the individual enterprise examine the value creation network formed by the key enterprises in the value chain and how that delivers value to the end customer. "The value network defines the reality of the business network" (Kothandaraman and Wilson, 2001). In this context it should be further understood that the "dynamics of value conversion requires expanding beyond the asset view of intangibles to understand the function of intangibles as negotiable goods and as deliverables" (Allee, 2008a). According to Allee value is "(...) an emergent property of the network, so, understanding the functioning of the network as a whole is essential to understand how and why value is created. (...)" (Allee, 2008a).

According to this literature review, it is clear that the concept of value has been defined in many theoretical contexts by focusing for example in "beliefs, competitive advantage, goal attainment, preferences and attitudes", and this suggests that value may be a "multi-dimensional construct that merits multiple measurement approaches" (Hogan, 2001).

The research presented in this work builds on the different dimensions of the value creation analysis proposed by (Allee, 2008a), comprising the asset utilization, value conversion, value enhancements, the transaction's perceived value and the social value. These constructs, used to model the value creation analysis, enable the implicit modelling of the "service logic" concept proposed by (Grönroos, 2008), however, this paper will not explicitly tackle this topic. The authors are therefore not only aware of the value co-creation but also that different customer segments will have different perceived values for offer (Ulaga and Eggert, 2006). The same way, members of the organization involved in the sales activities will have different perceptions of the perceived value of enterprise offer. Time also has a direct impact in the perceived value, from the pre-purchase to the post-purchase phases (Woodall, 2003, Huber et al., 1997). This approach provides the means to explain how customers perceived the value of the exchanged deliverables (both tangible and intangible) implied the product/service and how these are related to the enterprise endogenous/exogenous assets, and helps the firm formulate a clear statement of its VP in contrast with its competitors.

3 Research Questions and Methodology

3.1 Design Science Approach and Research Questions

Along this project we followed the Design Science approach (Hevner et al., 2004) to the development of the proposed model. This approach enabled the identification of an adequate match between the business need and the literature gap (Nicola et al.,

2010, Nicola et al., 2012). The validation followed the Case Study approach with an early exploratory case study that enabled the early design and assessment of the following research questions, having as background the definition of Value for the Customer proposed by (Woodall, 2003):

1. How can the Value for the Customer be modelled on top of the organization endogenous and exogenous assets?
   1.1 How is this value built on top of assets endogenous and exogenous to the organization?
   1.2 How do endogenous and exogenous assets influence the Value for the Customer?
2. Can we derive a formal mathematical model that provides for the quantitative handling of the proposed model?

According to the article of Dubé and Paré (2003), the "key criteria for the appropriate use of the case study method is the type of the research questions posed". The work of (Eisenhardt and Graebner, 2007) argue that cases studies typically answers to the "research questions that address 'how' and 'why' in unexplored research areas", helping researchers to clarify why the research questions are significant. Furthermore "in-depth case investigations open the way to new ideas and new lines of reasoning" (Dubé and Paré, 2003). In this context, we use the case study approach, as useful tool, to develop new insights and to support deeper and more detailed investigation that is necessary to answer the research questions. This also means that literature review is a continuous process that also helps paving the way to the building of "informed arguments" in the support of research results (Hevner et al., 2004).

3.2 Methodology

Case Study Selection

This paper consolidates the previous research in two other case studies by bringing a third case to the discussion. All cases were made in SMEs in Portugal in three different sectors, one in the sector of Occupational Safety and Health Services, the other Textile Industry sector, and the one discussed in this paper in the Footwear Industry sector. It has been clear that Portugal is facing one of the worsening employment crises. Increasingly, attention has turned to the micro-enterprises sector as a provider of employment. According to Eurostat 5% percent of microenterprises in European Union (EU) are located in Portugal, where they represent 95.4 percent of the sector of Small and Medium Enterprises and employ 41% of workers. According to data from the statistics office of the EU, the share of the sector of Small and Medium Enterprises (SMEs) in employment is in Portugal, 80.9 percent and 66.9 percent in the EU. "Microenterprises are much more dominant in the SME sector in Portugal than in almost all other Member States," reads the study on the essential contribution of the same for job creation presented by the European Commission (EC) (Lusa, 2012). Also, according to the National Statistics Institute, in 2011, "84.7% of non-financial corporations were microenterprises, while medium-sized firms accounted for 2% and large companies were only 0.4% of the total" (Santos, 2014). The enterprise where we are conducting this case study is, therefore representative of an important group of microenterprise for the Portuguese Economy.

The case study was conducted in the footwear industry, that has been the largest contributor to the external accounts since it is the sector with the largest trade surplus, revealed the database in Bank of Portugal (BdP 2012). The year of 2012 (BdP 2012) exceeded 1,3 billion euros in international sales (more than in 2011) and is expected to growth in 2013 with the strategy of the entrance in new markets such as United States, China and Chorea (Santos Pereira, 2013). Pontechem is an import/export enterprise with more than 20 years of experience. They are suppliers to

the footwear industry. In response to the customer needs they realized they had look for new products to offer their clients and became suppliers of other companies namely for the leather goods section, decoration, clothing and accessories. Pontechem key partners are the Company A, producing synthetic fabrics for various applications with a great capacity for innovation and adaptation on the growing market demand. At this moment, they have also as a key partnership a representation of prefabricated soles (Company B). Company A and B are aliases for existing companies that the authors are not allowed to disclose.

Approach to data collection and processing

Two personal semi-structured recorded interviews of two enterprise members were conducted, the Pontechem CEO, which is also the owner and the responsible of the synthetic-fabrics leather and soles sales department, and the person responsible for the Purchasing/Sales and Operations Planning (Figure 5). There was also one important meeting with the Pontechem CEO to position and clarify the research objectives and to provide a detailed explanation of the on-going research. Right after the interviews and after an in-depth analysis of the recorded interview, a first version of the Pontechem Value Network (PVN) was made. Figure 5 illustrates this value network identifying roles and exchanged deliverables, both tangible and intangible. Both interviewees were later asked to analyze the PVN and, together with the research team, improve and validate it. In the analysis of the case study the so-called Business Narrative Modelling Language (BNML) (Oliveira and Pinto Ferreira, 2011) was applied. The motivation for narrative analysis stems from the fact that "people use narratives to order their experience as they make sense of it." (Rhodes and Brown, 2005).The Narrative Analysis allows the analyst to understand and discover the intervening characters, the related facts and place of action, assisted by the plot structure given by the way how things were done and the time line of the occurred facts (Pentland, 1999, Costa and Ferreira, 2012). This was the motivation for the development of BNML (Oliveira and Pinto Ferreira, 2011).

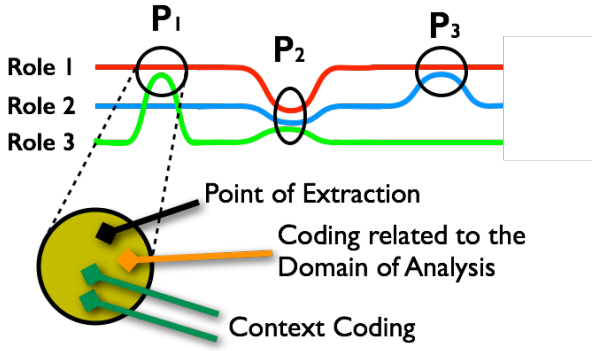


Fig. 1. The BNML Approach to Narrative Analysis

The BNML approach, illustrated in Figure 1 builds on semi-structured interviews from where we identify the so-called Points of Extraction. These are chunks of text that define a relevant segment of the story. The coding of each point of extraction involves two components: 1) the coding of the domain of analysis where we use keywords from existing Ontologies/Taxonomies provided by frameworks such as ARCON and authors such as (Woodall, 2003) and (Lapierre, 2001); 2) the coding of the business context where we use the "Business Model Ontology" (Osterwalder and Pigneur, 2010) and "Enterprise Ontology" (Uschold et al., 1998). The interview was segmented into different Points of Extraction, each modelled as one (or more) Microsoft Excel line establishing the relationship among the different terms of

coding scheme for both context and domain of analysis. Each line also includes text from the interview, thus providing the evidence that supports the rationale for those relationships. These terms are then connected and the Excel worksheet is then further processed using "pivot tables" in order to extract the desired perspectives on the data model. Further processing transforms these relationships into graphs using Graphviz (http://www.graphviz.org). The whole process is automated using excel macros, pivot tables and the open source Graphviz software. The final result is the visualization of graphs picturing the relationships among the keywords in the coding scheme for a particular context. This analysis was made for an Ex-Ante Phase (Pre-purchase phase).

4 A Conceptual Model for Decomposing Value for the Customer

The proposed Conceptual Model for Decomposing Value for the Customer builds on the combination of the following concepts: 1) the concept of Forms of value and Value temporal positions (Woodall, 2003); 2) the concept of Value Network and on the network exchange of tangible and intangible deliverables among the network roles, building on both tangible and intangible enterprise assets (Allee, 2000b, Allee, 2000a, Allee, 2002b), Allee, 2002a), Allee, 2008a); 3) the concept of Enterprise Endogenous and Exogenous assets, extracted from the Reference Model for Collaborative Network Organizations (ARCON) (Camarinha-Matos and Afasarmanesh, 2008b, Camarinha-Matos and Afasarmanesh, 2008a); and at last 4) on the concept of Perceived Benefits(PBi)/Sacrifices (PSi) (Lapierre, 2000, Lapierre, 2001, Woodall, 2003). The combination of these perspectives in the proposed Conceptual Model for Decomposing Value for the Customer, are then formalized in a quantitative model that uses techniques that stem from the area Multi-Criteria Decision Making. The concept of triangular fuzzy numbers was further introduced in the model in order to handle the implied uncertainty and subjectivity of the assessed perceptions. The following three pictures illustrate the proposed model and its usage as a sequence of three steps towards the final assessment of the enterprise Value Proposition (VP) and how this VP is supported by enterprise tangible and intangible Assets (endogenous/exogenous).

STEP 1: Figure 2 pictures the first step. The objective is to understand how value for the customer could be broken down into simpler constituents, integrating the value perceived by the enterprise members for a particular time position. The construction of the enterprise Value Network (through an interview with enterprise members), provides the identification of each tangible and intangible deliverable (DL) exchanged with the customer, as well as the assets (endogenous and exogenous) built and/or used in the provision of that deliverable. This analysis further relates each deliverable (DL) with the forms of value. Some authors (De Toni and Tonchia, 2003) argue for a need to integrate the traditional "outside-in (which analyses the source of competitive analysis outside the enterprise)" and "inside-out (which analyses the source of competitive analysis inside the enterprise)" views of the enterprise into a competence theory. In this context we apply the concepts proposed by the Reference Model for Collaborative Organizations, to classify the assets built and/or used as endogenous or exogenous to the enterprise.

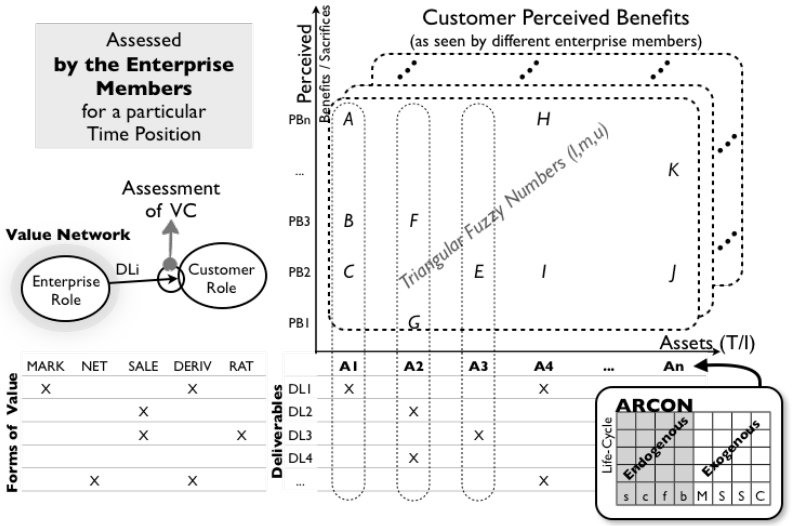


Fig. 2. Customer Perceived Value assessed by the Enterprise Members for a particular Time Position

The proposed model, at this stage, pictures the perspective of the enterprise members. This shows: 1) how does the people inside the enterprise perceive the relative relevance of the assets involved in the process; and 2) how these assets relate to the Perceived Benefits (PBi)/Sacrifices (PSi) using the Saaty's scale (Saaty, 1990). These two components are modeled as a comparison matrix of the triangular fuzzy numbers resulting from: i) each enterprise member assesses each asset relative relevance; and ii) assesses the relevance of each asset to each Perceived Benefit (PBi)/ Sacrifice (PSi). The combination of these comparison matrixes provides the input to a process that leads to the construction of the final matrix where we will be able to extract the most relevant assets and Perceived Benefits and Sacrifices.

STEP 2: In the 2nd step of this process, Figure 3, the objective is to obtain further information from the enterprise client/customer for a particular Time Position and regarding his perception of benefits and sacrifices. In this step and following the conclusions of the previous analysis, one takes the most relevant assets to select which deliverables will be used to assess how the customer perceives the enterprise value proposition. This step is taken in order to reduce the burden on the customer on the number of comparison tables that he/she will have to fill. However, and to ensure that we do not eliminate any relevant deliverable, a brief interview with the customer helps ensuring that we get the most relevant set of deliverables analyzed. In this step, the customer assesses the relevance of each deliverable to each PBi/PSi using the Saaty's scale (Saaty, 1990).

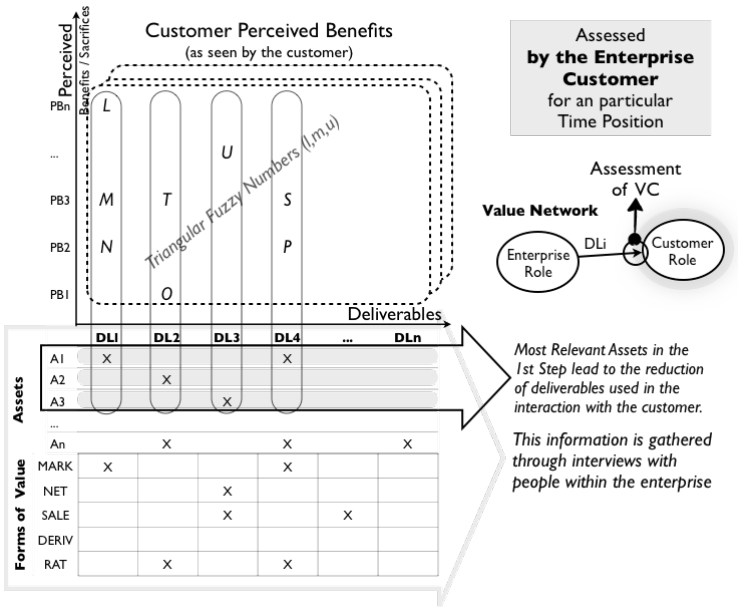


Fig. 3. Customer Perceived Value assessed by the Enterprise Customers for a particular Time Position

STEP 3: Figure 4 pictures the last step of the assessment of the enterprise Value Proposition and of its supporting assets. This analysis combines the two described streams, the Enterprise perspective on the left and the Customer perspective on right. Let us analyze each of the steps in more detail in the following paragraphs.

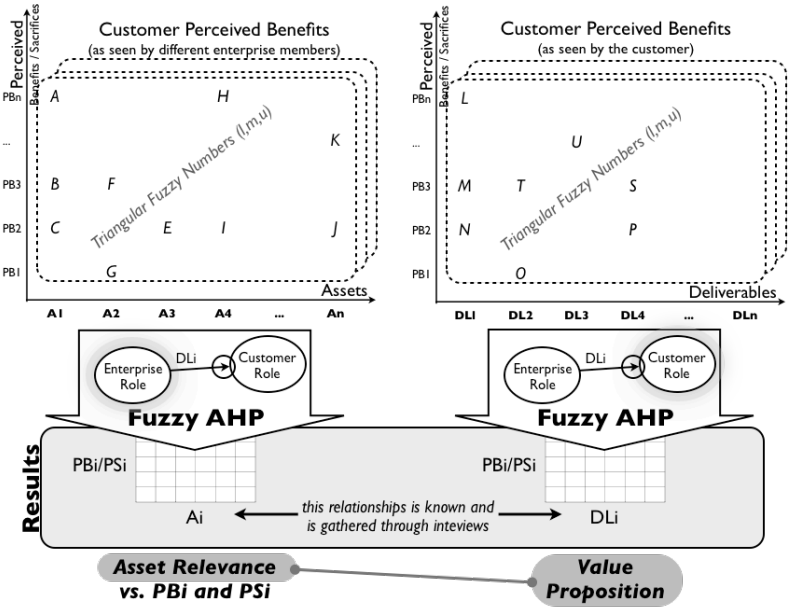


Fig. 4. Wrap-up and assessment of results

The Enterprise Perspective (1st Step)

For the enterprise we have a several and conflicting criteria (Assets and Deliverables) and alternatives (Perceived Benefits/Sacrifices) where an assessment is not easily determined. The input information containing the enterprise members' subjective judgements relating criteria and alternatives, is uncertain and imprecise. In this context, the fuzzy theory is usually applied to handle uncertain and subjective problems in the decision-making process. Therefore we apply the fuzzy Analytical Hierarchical Process (AHP) to solve this multi-criteria decision-making (MCDM) problem (Chen, 2004b, Chen et al., 2005, Deng, 1999, Fu et al., 2007). The process unfolds as follows. Each enterprise member is performs an individual pair-wise comparison using the Saaty's scale. Then a comprehensive pair-wise comparison matrix (eq. 3) is built by integrating the enterprise member's grades (b_{jep}) through the equations (1-2) (Chen, 2004a), where enterprise members pair-wise comparison value is transformed into triangular fuzzy numbers.

$$l_{je} = min(b_{jep}), m_{je} = \frac{\sum_{p=1}^{t}(b_{jep})}{p}, u_{je} = max(b_{jep}),$$
$$p = 1,2,\dots,t;\ \ j = 1,2,\dots,m;\ \ \ e = 1,2,\dots,m \tag{1}$$

$$\tilde{b}_{je} = (l_{je};\ m_{je};\ u_{je}),\quad j = 1,2,\dots,m;\ \ \ e = 1,2,\dots,m \tag{2}$$

Then we apply the approach of Chang (Chang, 1996) for handling fuzzy AHP, by using the "extent analysis method" for the synthetic extent values, which derives crisp weights for fuzzy comparison matrix. Consider a triangular fuzzy comparison matrix (eq.3) obtained by the steps of Chen (2004):

$$\tilde{D}_p = (\tilde{b}_{ij})_{n\times n} = \begin{bmatrix} \tilde{b}_{11} & \tilde{b}_{12} & \cdots & \tilde{b}_{1m} \\ \tilde{b}_{21} & \tilde{b}_{22} & \cdots & \tilde{b}_{2m} \\ \vdots & \vdots & \ddots & \vdots \\ \tilde{b}_{m1} & \tilde{b}_{m2} & \cdots & \tilde{b}_{mm} \end{bmatrix}$$
$$= \begin{bmatrix} (1,1,1) & (l_{12},m_{12},u_{12}) & \cdots & (l_{1n},m_{1n},u_{1n}) \\ (l_{12},m_{12},u_{12}) & (1,1,1) & \cdots & (l_{2n},m_{2n},u_{2n}) \\ \vdots & \vdots & \ddots & \vdots \\ (l_{n1},m_{n1},u_{n1}) & (l_{n2},m_{n2},u_{n2}) & \cdots & (1,1,1) \end{bmatrix} \tag{3}$$

where $\tilde{b}_{ij} = (l_{ij}, m_{ij}, u_{ij}) = \tilde{b}_{ij}^{-1} = \left(\frac{1}{u_{ij}}, \frac{1}{m_{ij}}, \frac{1}{l_{ij}}\right)$ for $i, j = 1, \dots., n$ and $i \neq j$.

To calculate a priority vector of the above triangular fuzzy comparison matrix $\tilde{D}_p$, the steps of Chang's extent analysis can be given as in the following:

1) First, sum up each row of the fuzzy comparison matrix $\tilde{D}_p$, by applying the fuzzy arithmetic operations:

$$\sum_{j=1}^{n} \tilde{b}_{ij} = \left(\sum_{j=1}^{n} l_{ij}, \sum_{j=1}^{n} m_{ij}, \sum_{j=1}^{n} u_{ij}\right), \qquad i, j = 1,2,\dots,n \tag{4}$$

Then the inverse of the vector (eq.4) above is:

$$\left[\sum_{j=1}^{n} \tilde{b}_{ij}\right]^{-1} = \left(1/\sum_{j=1}^{n} u_{ij}, 1/\sum_{j=1}^{n} m_{ij}, 1/\sum_{j=1}^{n} l_{ij}\right) \quad (5)$$

2) Second we normalize the rows sums (eq.5) by:

$$\tilde{S}_i = \sum_{j=1}^{n} \tilde{b}_{ij} \times \left[\sum_{j=1}^{n} \tilde{b}_{ij}\right]^{-1} \quad (6)$$

3) Third, compute the degree of possibility for $\tilde{S}_i \geq \tilde{S}_j$ of two TFNs $\tilde{S}_i = (l_i, m_i, u_i)$ and $\tilde{S}_j = (l_j, m_j, u_j)$ by the following equation (7):

$$V(S_i \geq S_j) = \begin{cases} 1, & if\ m_i \geq m_j \\ 0, & if\ l_j \geq u_i \\ \dfrac{l_j - u_i}{(m_i - u_i) - (m_j - l_j)}, & otherwise \end{cases} \quad (7)$$

a) In general, the priority weights are calculated by using the equation 8:

$$d'(A_i) = min\, V(S_i \geq S_k)\ \ k = 1,2,\dots,n; k \neq i \quad (8)$$

are the pair wise comparison of the $\tilde{S}$ TFNs.

b) Then the weight vector is given by the equation 9:

$$W' = \left(d'(A_1); d'(A_2); \dots; d'(A_n)\right)^T \quad (9)$$

c) Finally we normalized the weight vector (eq.10)

$$W = \left(d(A_1); d(A_2); \dots; d(A_n)\right)^T \quad (10)$$

where W is a non-fuzzy number.

By applying the fuzzy AHP method we obtain a matrix of overall results of the enterprise member perception of the relevant assets and the relevant PBi/PSi.

The Customer Perspective (2nd Step)

To obtain the matrix of the overall results for the enterprise customer perception relating relevant deliverables as well as the relevant PBi/PSi, the customer will have to make their pair-wise comparison using the Saaty's scale for the deliverables and for the perceived benefits and sacrifices. We then transform the customer perceptions using the Saaty's scale, by converting them into triangular fuzzy numbers using a comparison scale (Herrera Umaña and Osorio Gómez, 2006). As we have the comprehensive pair-wise comparison matrix (eq.1-2), we applied the "extent analysis method" for the synthetic extent values (eq.4-10).

Integrating the two Perspectives (3rd Step)

With these two matrixes we have the degree of priority one criterion or alternative against all others in a fuzzy comparison matrix, (Wang et al., 2008). On the left we have the degree of priority (relevance) as seen by the enterprise of an Asset and its relation to a PBi/PSi, whereas on the right we have the degree of priority (relevance) as seen by the customer of deliverable and its relation to a PBi/PSi. The relationship between the assets and the deliverables is known, which means that one now should

be able to understand how the enterprise assets (endogenous or exogenous) relate to PBi/PSi, thus enabling the tuning of the enterprise offer Value Proposition.

4.1 Applying the Conceptual Model Decomposing Value for the Customer in the footwear industry

Figure 5 shows the outcome of a value network analysis performed at Pontechem, picturing roles or actors in the value network, including the four functional departments, as well as other two external entities (suppliers). The dashed lines show that an intangible deliverable has been exchanged (e.g "Requirements for new collection" (DL3) and "Product Information" (DL2) whereas the solid lines show the tangible deliverable exchanges (such as payment, sale confirmation)) (Allee, 2008a).

This study will focus on four roles:

- The Pontechem CEO is responsible for the role Sales Synthetic-Fabrics PT/N and Soles (PT). This role assures the sales fabric and synthetic leather in north and centre of Portugal and also soles for the whole country. He creates the environment in which the client decides to buy, in learning what people want and need trying to persuade them to buy. In this context, the information about their products ("Product Information" – DL2) is critical to their client, and must clearly identify the diversity and specifications of their raw material, as well as their certifications and the minimum quantities of the product the client could acquire. This role also comprises the continuous search on "Products Innovation" (DL5) among both current and potential suppliers. This involves the participation in fairs, visits to suppliers, understanding fashion trends and reporting the "Requirements for new collections" (DL3). In their sales and promotion activities they build on with their "Knowledge and experience about the process" (DL4) provided by their suppliers and also on many years of experience in this market.
- The Sales Synthetic-Fabrics PT/S develops the same activities as above (except for the soles) in centre and south of Portugal.
- The Shipping role is responsible for managing the delivery of Synthetic-Fabrics and Soles to the clients. Soles are in fact shipped directly from the producer, whereas the Synthetic-Fabrics and received by Pontechem and then shipped to the clients.
- The Purchasing/Sales & Operations Planning role is responsible for the financial area and the management of daily operations between suppliers and clients, namely:
    a) Acquiring material from suppliers, by requesting: "Quotation" (DL7), "Purchasing Order" (DL6);
    b) "Material requirements & due dates" (DL14) as well their confirmation ("Confirm Delivery due dates" (DL15)), ensuring the clients' orders will be shipped right on time;
    c) "Payment" (DL16) for the suppliers;
    d) Receiving from the suppliers' new designs and models for both Sales Synthetic-Fabrics and Soles: "Research on new design and models" (DL13).

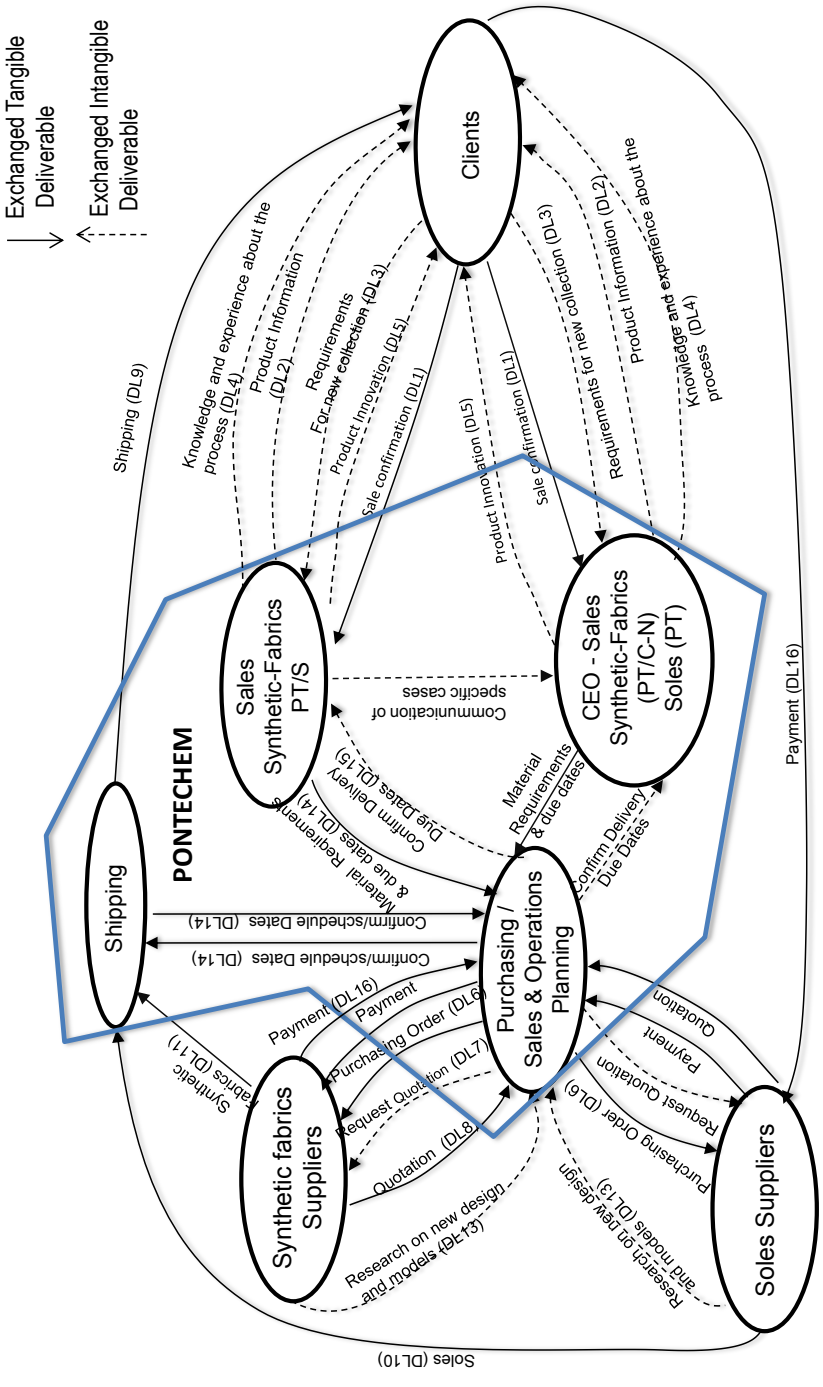


Fig. 5. Pontechem Value Network

4.2 Value for the Customer vs. Endogenous and Exogenous Assets

In this paragraph we discuss fundamentally the first research question:

1. How can the Value for the Customer be modeled on top of the organization endogenous and exogenous assets?
   1.1 How is this value built on top of assets endogenous and exogenous to the organization?
   1.2 How do endogenous and exogenous assets influence the Value for the Customer?

The analysis of this research questions, will enable the assessment that the relationships that we have proposed in our model are verified and confirmed in real world. We limited the discussion at a particular time position, an Ex-Ante phase, corresponding to the period before the handing of the contract proposal to the customer, as it relates to the perceived Value for the Customer "whenever they contemplate the purchase" (Woodall 2003, p10). In an Ex-Ante (EXA_VC) value temporal position, the customer will make some judgments and predictions to maximize the value of the product/service to be acquired. In this phase, the customer starts to think what can be expected (such as "expected value" (Huber et al., 1997, Parasuraman, 1997) from their products/services and what is desirable (such as "desired value" (Flint et al., 1997)) of the value proposition of the enterprise. These expectations are related to both benefits expect from the product/service as well as sacrifices the customer is prepared to make upon its acquisition (Komulainen et al., 2005). Also, as a desired value is what the customer wants to happen and the benefits is seeking for. So this phase seems most interesting to study, because this will reduce the uncertainty the enterprise has in understanding the customer needs and in trying to maximise the ex-post happiness (Woodall, 2003). The next sections will illustrate the relationship between forms of value with endogenous and exogenous assets. This is shown in the form of graphs, using pictures to support the explanation of their relationship rational in an Ex-Ante phase: 1) the relationship between the exchanged deliverables and how different forms of value emerge in this phase; 2) the connections between deliverables, assets and ARCON Endogenous and Exogenous Components.

Forms of Value and deliverables

In the Figure 6, three forms of value emerged for this phase: Marketing (MARK_VC), Net (NET_VC) and Sale (SALE_VC).

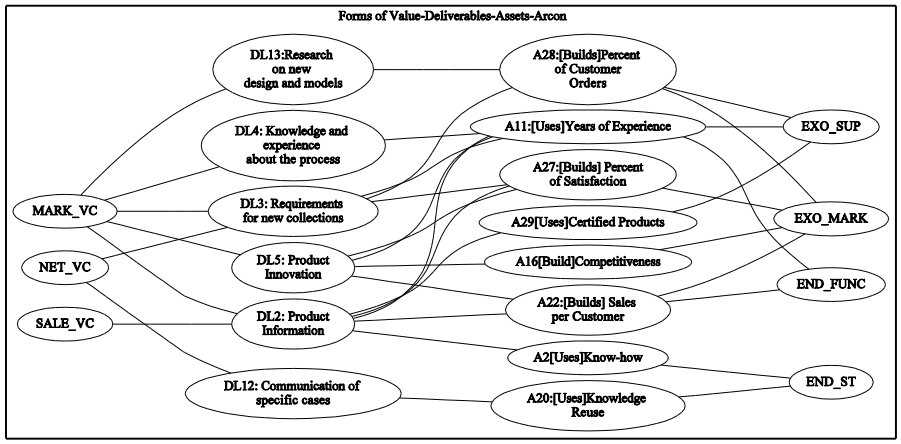


Fig. 6. Map of Emerging Relationships: Forms of Value, Deliverables, Enterprise Assets and

Types of endogenous and exogenous components (Ex-Ante Phase)

Marketing VC

From the literature, MARK_VC is related with a "pre-experience zone and can be best associated with an Ex-Ante temporal position" (Woodall, 2003 p17). MARK_VC is seen as a "perceived component", because "suppliers can never predict how each consumer will perceive and react to specific service" (Woodall, 2003 p17), that´s why MARK_VC is the form of value related with almost all deliverables. This is about combining the supply side and the demand side interpretations of the enterprise offering.

1. "Product Information" (DL2). The client needs to be confident that the information of the product is correct and up to date. They inform the customers of all kind of products for making the footwear and for all new innovations in each collection;
   "(…) we provide information about our products including minimum quantities, product certification, complete product portfolio and innovative products. We have to ensure [through product certification by our suppliers] that our products do not contain PVC, acids, acetone or enzymes. (…) This is an advantage for our clients that will also in having their products certified, instead having to make tests with raw material bought in other countries that do not have the European specification requirements. (…) We also have no child labour. (…)" (Interview excerpts)
2. "Knowledge and experience about the process"(DL4) it is an important deliverable since according to the interview "(...) the client knows very little about raw materials and even about the process applying and combining these raw materials (…)". The Knowledge of the raw material "(…) is vital to a salesperson's effectiveness, because we must always be attentive to ever-changings client needs, other market trends, competitors' products or services as well as new products to answer the questions of our clients" (interview excerpt). Without it the company will have lack of credibility and confidence;
3. "Product Innovation" (DL5) it is about search for new products;

   "(…) in the footwear industry we must constantly innovate and search for new products. According to the product innovation they know we have a multiple sources of new products and we are constantly innovating" (interview excerpt).
4. "Research on new design and models" (DL13) (suppliers). Suppliers must constantly improve the manufacturing processes, must be proactive and anticipate client needs.

NET VC

In the NET_VC the client is focusing purely "on the balance of benefits/sacrifices" (Woodall, 2003 p7). By looking at the "Requirements for new collections" (DL3), the customer will make a balance of benefits/sacrifices as a utilitarian perspective on purchase and consumption. DL3 is related with a particular characteristics and specifications of a product/service made by the customer.

> *"An example of a requirement is when a clients wants a specified material, for instance, a fabric mounted on cork." (Interview excerpts)*

This relates the benefit of the innovation and its value perception by the end-consumer, versus the difficulty of having a fabric properly mounted on cork. As an outcome perspective the evaluation of the benefits and sacrifices "(…) has to be done by the client (…)" (interview excerpt).

However it is important that Pontechem helps the client in assessing balance the

involved benefit and sacrifices. This implies a consistent and in-depth knowledge of all materials and how they can, or not, be used together. This assistance is important and valued by the enterprise clients that will, along the process, buy innovative materials for footwear.

Quoting the interviewee:

> *"(…) if we contributed to clients gains they can come again and buy our products [Building percent of Client orders]. From the point of view of the client we can advise them if it is feasible or not [to use or combine particular raw materials], contributing for their satisfaction" (interview excerpt).*

SALE VC

SALE_VC, as a concept, relates only to the reduction of sacrifice "(…) predicted purely upon units of exchange (…) and influence perceptions of VC at EX-Ante (…)" phase (Woodall, 2003 p19). In this form of value, the client perceives the price, the quality of products, the services, according to the information of the enterprise products ("Product Information" - DL2).

Deliverables vs. Endogenous/Exogenous Assets

The previous discussion related forms of value and their relationship with each deliverable for the Ex-Ante time position and is illustrated in Figure 6. This picture also shows the relationship between each deliverable, the enterprise assets being used or built and the projection of each asset into the types of endogenous and exogenous components. The following discussion will use the deliverable "Product Information" (DL2) as an example to illustrate this relationship. The same exercise was extended to the other deliverables thus further demonstrating the answer to research question 1.1 and 1.2. The authors, however, refrained from including here all this description in order to make this document shorter and more convenient to read.

Deliverable DL2 is about providing information about Pontechem products and services: 1) relates to certified products by [Using] Certified Products (A29); 2) and to the diversity of their product portfolio and to their ability to suggest improvements the client's products by [Using] Years of Experience (A11), and Know-how (A2) (using their knowledge) to help clients achieve their goals. Pontechem wants to increase sales [Building] asset A22 (Sales per Customer) and [Build] Percentage of Satisfaction (A27) among their clients.

[Building] Sales per Customer (A22)

The asset [Building] Sales per Customer (A22) will be projected into: 1) Endogenous Functional (END_FUNC), reflecting on the competency of their human resources, such as CEO and the personal of the enterprise, in their procedures and methodologies to sale their raw material; 2) Exogenous Market (EXO_MARK) related with the interaction with clients by giving them information about the competence of their services and products in acquiring potential sales and new clients.

[Use] Certified Products (A29)

The asset [Using] Certified Products (A29) will be projected into Exogenous Support (EXO_SUP), reflecting both the suppliers role and their certification provided by those entities that are entitled to issue certificates confirming compliance with regulations and norms.

[Use] Know-how(A2)

The asset [Use] Know-how will be projected into Endogenous Structural (END_ST), reflecting a direct participation in the main business process, responsible for operation and collaboration among its actors, (Camarinha-Matos and Afasarmanesh, 2008b). The CEO is responsible for the daily general support activities to their clients

by helping them solving all different problems that arise from the usage of supplied materials. The CEO [Uses] know-how to perform these enterprise activities.

Discussion

The focus of this section was answer the 1st research question, to understand how we could model the Value for the Customer. At this stage we aimed at understanding how value was built on top of assets endogenous and exogenous to the organization and how do those assets influence or relate the Value for the Customer. This brief illustration using DL2, "Product Information" helped demonstrating the relevance of both endogenous and exogenous assets, of different types (e.g.: Endogenous Functional, Exogenous Support and Exogenous Market) to the construction of the value for the customer. Our objective, however, is to build on a quantitative model that may help us in the decision making process. This will be discussed in the following sections.

5 Value For the Customer Quantitative Model, Application and Discussion

Now that the relevance of both endogenous and exogenous assets for the Value for the Customer was demonstrated, we want to address the second research question:

1. Can we derive a formal mathematical model that provides for the quantitative handling of the proposed model?

Moreover, as illustrated in the proposed model presentation we would like to use this quantitative model to support the tuning of the enterprise Value Proposition. To this end the client or end-customer perceived benefits and sacrifices have to be understood and included in the equation. As a result, this section is organized as follows. We start by introducing the list of relevant perceived benefits and sacrifices derived from the interview at the enterprise. We then use the Fuzzy AHP method to assess the two "sides", that is, the enterprise perspective and the client perspective. Finally we integrate both results in a final analysis of the value proposition.

5.1 Perceived Benefits and Sacrifices

The detail of the Perceived Benefits (PBi) and Sacrifices (PSi) related to the previously identified exchanged deliverables and enterprise assets at an EX-Ante time position were derived from the interview at Pontechem and listed in a table that contains the whole set of PB/PS identified in the existing deliverable exchange. This table may be found in annex in Table A.1.

5.2 Using the Fuzzy AHP extent analysis on the enterprise perspective

One of the most common Multi-Criteria Decision Making (MCDM) techniques is Analytical Hierarchy Process (AHP) (Ahmad et al., 2006, Ahmad and Laplante, 2009, Peng et al., 2011). As the direct application of AHP cannot reflect the human thinking (Nukala and Gupta, 2005, Vahidnia et al., 2008), in this study AHP will be used together with fuzzy theory. The authors believe this approach is better in dealing with ambiguous and self-defined situations (Aggarwal and Singh, 2013). The so-called Fuzzy AHP method uses the Saaty's scale for each decision maker, individually carrying out each pair wise-comparison for the criteria/alternatives. In our case study, a comprehensive pair-wise comparison matrix (eq.3) is built, integrating the three perceptions of the two decision makers and client (as perceived by the company). Using equation (eq.1-2), these values are transformed into

triangular fuzzy numbers ($\tilde{b}_{je}$). Then, the extent analysis is used to obtain the synthetic extent value (Chang, 1996) of the pair-wise comparison.

In this context, in order to evaluate the criteria and the alternatives, the interviewees in the enterprise graded the pair-wise comparison by using the Saaty's scale giving: 1) the relative importance between each Criterion (8 Assets); 2) for each Criterion (Asset), the relative importance of each and every Alternative (13 PB/PS). The overall calculations by using the fuzzy AHP method, through the equations (3-10), are depicted in the Table 1, showing: a) the relative relevance of the enterprise assets involved (colour grading column); b) the ranking of alternatives obtained for the Perceived Benefits/Sacrifices (colour grading in the bottom row); c) the relationship between Assets and Benefits that were not identified during the interview; d) the deliverables identified with each asset (endogenous/exogenous); e) the form of value related with each deliverable.

Relative importance between each Criterion

According to the pair-wise comparison of the company and after the calculation by using the AHP Fuzzy Method, Table 1, the higher value emerges for the exogenous market (EXO_MARK) asset [Builds] Competitiveness (A16). Pontechem must identify opportunities for achieving sustainable competitive advantage (Camarinha-Matos and Afasarmanesh, 2008, p105), which means the enterprise must focus on partnerships to achieve its goals, "showing the best potential value within their chosen marketplace" (Woodall, 2003) by delivering adequate "Product Innovation" (DL5) in the communication of their value proposition. The interview comments to this result make this clear:

> *"(…)due to the fact of our collection changes from to season to season it is necessary to look for our client needs. We have a high variety of articles. The client is going to find whatever he wants and the prices are not high. This saves the client the need to undergo further developments and increases competitiveness. Basically we provide reliable products that our clients trust. Our products are also trendy and innovative, thus meeting their needs for the new season collections." (interview excerpt).*

The relevance of A16 emerges firstly from the price (PS22). Then we have the Reliability (PB46), the quality of their Products and Services (PB2, PB4) and Trust (PB49). These PB and PS were indeed mentioned in the interview but not related with A16. This is an interesting result. Indeed, during the interview the whole list of PB/PS was analyzed one at a time, however, as result of the pair-wise comparison, these new relationships emerged. The discussion of these results with the interviewee confirm the rational for those relationships:

> *"(...) Our advantage is the diversification and the quality of our products, service and innovation. (…)There is an amount of different and innovative products each year in each collection. Also, the client may come to us and get everything to make shoes." (Interview excerpts)*

The asset [Uses] Years of experience (A11) was ranked second. The perceived benefits with higher values on using this asset were Reliability (PB46) and Trust (PB49). The client perceived Reliability as "the ability of the supplier to do things right at the first time" (Lapierre, 2001 p255) and perceived Trust, as the ability to honour his promises capturing the client confidence that the enterprise is telling the truth about the products. The interview testimonials confirm the rational for those relationships:

> *"(…) we need to know if the product is technically feasible and this knowledge results from our years of experience in the footwear market. Indeed, the reliability more than trust is very important in our business." (Interview excerpts)*

Ranking of alternatives obtained for the Perceived Benefits

For the ranked alternatives, the highest priority vector of the PB/PS was PS22 – Price. Thus, it is the most important alternative that the enterprise may take into account in the decision making process, followed by PB46-Reliability, PB2–Product quality and PB4–Service quality. These results were confirmed by the enterprise and emphasized by some authors, whose words can be summarize as: "price is always a part of the client's value calculation (…) and is one of the elements which is given up to obtain a product or a service" (Woodall, 2003, Zeithaml, 1988). PB46-Reliability is ranked second and is defined "as the ability of the supplier's to keep his promises and the accuracy of the transactions" (Lapierre, 2001). In this context, [Using] Years of experience (A11), Certified Products (A29) and Knowledge Reuse (A20) are contributing for PB46-Reliability. The relationship between assets and benefits that were not identified during the interview are the cells in white background. It is interesting to see that A16 is a very important asset, although the PB associated with it (as mentioned in the interview) has not the highest value in the whole set of PBs/PSs. The results revealed that four perceived benefits emerged with a fuzzy weight vector bigger than those mentioned in the interview, namely: PB46-Reliability, PB4-Service quality; PB2-Product quality and PB49-Trust. These relationships are explained by the Saaty's scale ranking of alternatives, thus leading to the analysis of previously disregarded relationships.

Table 1. Overall Results of Pontechem (eq.10)

Forms of Value	Deliverables	ARCON	Assets	PB2 Product Quality	PB4 Service Quality	PB17 Product Attributes	PB21 Utility	PB26 Logistics Benefits	PB28 Strategic Benefits	PB29 Financial benefits	PB43 Product Customization	PB46 Reliability	PB47 Technical Competence	PB49 Trust	PS3 Monetary Costs	PS22 Price	Weight Priority vector of the Assets
SALE_VC	DL2 Product Information	END_ST	A02 [Uses] Know-how	0,1038	0,0554	0,0486	0,0884	0,0217	0,0407	0,0976	0,0473	0,1388	0,0956	0,0935	0,0663	0,1023	0,1498
MARK_VC	DL4-Knowledge and experience about the process; DL5 Product Innovation; DL3 Requirements for new collections	END_FUNC EXO_SUP	A11 – [Uses] Years of experience	0,1007	0,1271	0	0,1116	0,0016	0	0,1229	0	0,1821	0	0,1637	0,0413	0,1489	0,1904
SALE_VC; MARK_VC	DL2 Product Information;DL5 Product Innovation	END_FUNC EXO_MARK	A22[Builds] Sales per Customer	0,1487	0,1095	0	0,1447	0	0	0,1101	0,0307	0,1115	0	0,1068	0,0702	0,1679	0,1093
NET_VC	DL12 Comunication of specific cases	END_ST	A20[Uses] Knowledge Reuse	0,1089	0,0534	0,0455	0,0939	0,0141	0,0366	0,1018	0,0312	0,1483	0,0995	0,0933	0,0659	0,1076	0
MARK_VC; SALE_VC	DL5 Product Innovation;DL3 Requirements for new collections;DL2 Product Information	EXO_MARK	A27[Builds] Percent of Satisfaction	0,1576	0,1151	0	0,108	0,0465	0	0,1003	0,0481	0,1283	0	0,0971	0,0457	0,1534	0,1608
MARK_VC	DL13 Research on new sdesign and models; DL3 Requirements for new collections	EXO_SUP	A28[Builds] Percent of Customer Orders	0,1363	0,1111	0,0104	0,149	0,0164	0,007	0,1058	0,0496	0,1062	0,0109	0,0883	0,0645	0,1444	0
SALE_VC	DL2 Product Information	EXO_SUP	A29 [Uses] Certified Products	0,251	0	0,2239	0	0	0,0206	0	0	0,2224	0,0914	0	0,0256	0,1652	0
MARK_VC	DL5 Product Innovation	EXO_MARK	A16 [Build] Competitiveness	0,1317	0,1395	0,0303	0,0518	0,0445	0	0	0,108	0,1586	0,0014	0,1261	0,0299	0,1782	0,3897
			Weight Priority vector of the PB/PS	0,127641	0,11733834	0,01908819	0,08785953	0,02837415	0,00609686	0,06618281	0,06026313	0,15008809	0,01486646	0,12160287	0,04446871	0,15613783	

Remark: shaded squares in the matrix picture the PB/PS associated to each deliverable during the interview and the construction of the Value Network. The other relationships emerge upon the pair-wise comparison of the different criteria/alternatives.

5.3 Results from the integration on the customer perception

Upon the attempt to get information from the client, regarding his perception of benefits and sacrifices, and their relationship with the Pontechem deliverables, the research team along with Pontechem members, decided to concentrate only on the assets with higher relevance to identify which deliverables would have to be analyzed by the client. The results of the matrix of the Table 1, led to the use of the the following deliverables, for evaluation the criteria with the client: "Product Information" (DL2); "Requirements for new collections" (DL3); "Knowledge and experience about the process" (DL4) and "Product Innovation" (DL5). The client made the pair-wise comparison using the Saaty's scale for these deliverables and then, because we have only one client, we transformed the client perceptions set into triangular fuzzy numbers using the comparison scale proposed by (Herrera Umaña and Osorio Gómez, 2006). The calculated the results are in Table 2. After this calculation and by applying the extent analysis method on fuzzy AHP method we obtain the priority weight vector (eq.10) for the deliverables:

$$W_{DL} = [0{,}1949 \quad 0{,}4025 \quad 0 \quad 0{,}4025].$$

Table 2. The fuzzy comparison matrix over different criteria

Criteria	DL2-Product Information			DL3- Requirements for new collections			DL4-Knowledge and experience about the process			DL5- Product Innovation		
DL2-Product Information	1	1	2	0,25	0,333	0,5	4	5	6	0,25	0,333	0,5
DL3- Requirements for new collections	2	3	4	1	1	2	4	5	6	1	1	2
DL4- Knowledge and experience about the process	0,167	0,2	0,25	0,167	0,2	0,25	1	1	2	0,167	0,2	0,25
DL5- Product Innovation	2	3	4	0,5	1	1	4	5	6	1	1	2

To assess the alternatives, we used all PB/PS except PB21 (Utility) and PS3 (Monetary Costs). Table 3 illustrates two of the four matrixes resulting from this process.

Table 3. Fuzzy comparison matrix with respect to DL2 and DL3

DL2	PB2 Product Quality			PB4 Service Quality			PB17 Product Attributes			PB26 Logistics Benefits			PB28 Strategic Benefits			PB29 Financial benefits			PB43 Product Customization			PB46 Reliability			PB47 Technical Competence			PB49 Trust			PS22 Price		
PB2 Product Quality	1	1	2	2	3	4	1	1	2	4	5	6	0,25	0,33	0,5	0,25	0,33	0,5	8	9	9	0,17	0,2	0,25	1	1	2	4	5	6	1	1	2
PB4 Service Quality	0,25	0,33	0,5	1	1	2	0,25	0,33	0,5	4	5	6	0,17	0,2	0,25	0,25	0,33	0,5	2	3	4	0,13	0,14	0,17	0,25	0,33	0,5	1	1	2	0,17	0,2	0,25
PB17 Product Attributes	0,5	1	1	2	3	4	1	1	2	4	5	6	0,17	0,33	0,5	0,25	0,33	0,5	8	9	9	0,17	0,2	0,25	1	1	2	4	5	6	1	1	2
PB26 Logistics Benefits	0,17	0,2	0,25	0,17	0,2	0,25	0,17	0,2	0,25	1	1	2	0,13	0,14	0,17	0,13	0,14	0,17	1	1	2	0,13	0,14	0,17	0,13	0,14	0,17	0,13	0,14	0,17	0,13	0,14	0,17
PB28 Strategic Benefits	2	3	4	4	5	6	2	3	4	6	7	8	1	1	2	2	3	4	8	9	9	1	1	2	1	1	2	4	5	6	1	1	2
PB29 Financial benefits	2	3	4	4	5	6	2	3	4	6	7	8	0,25	0,33	0,5	1	1	2	8	9	9	1	1	2	1	1	2	4	5	6	1	1	2
PB43 Product Customization	0,11	0,11	0,13	0,25	0,33	0,5	0,11	0,11	0,13	0,5	1	1	0,11	0,11	0,13	0,11	0,11	0,13	1	1	1	0,11	0,11	0,13	0,17	0,2	0,25	0,13	0,14	0,17	0,17	0,2	0,25
PB46 Reliability	4	5	6	6	7	8	4	5	6	6	7	8	0,5	1	1	0,5	1	1	8	9	9	1	1	2	6	7	8	7	8	9	4	5	6
PB47 Technical Competence	0,5	1	1	2	3	4	0,5	1	1	6	7	8	0,5	1	1	0,5	1	1	4	5	6	0,13	0,14	0,17	1	1	2	4	5	6	0,25	0,33	0,5
PB49 Trust	0,17	0,2	0,25	0,5	1	1	0,17	0,2	0,25	6	7	8	0,17	0,2	0,25	0,17	0,2	0,25	6	7	8	0,11	0,13	0,14	0,17	0,2	0,25	1	1	2	0,17	0,2	0,25
PS22 Price	0,5	1	1	4	5	6	0,5	1	1	6	7	8	1	1	2	0,5	1	1	4	5	6	0,17	0,2	0,25	2	3	4	4	5	6	1	1	2

DL3	PB2 Product Quality			PB4 Service Quality			PB17 Product Attributes			PB26 Logistics Benefits			PB28 Strategic Benefits			PB29 Financial benefits			PB43 Product Customization			PB46 Reliability			PB47 Technical Competence			PB49 Trust			PS22 Price		
PB2 Product Quality	1	1	2	0,13	0,14	0,17	1	1	2	1	1	2	0,13	0,33	0,5	0,25	0,33	0,5	0,13	0,14	0,17	0,17	0,2	0,25	1	1	2	0,13	0,14	0,17	0,17	0,2	0,25
PB4 Service Quality	6	7	8	1	1	2	6	7	8	6	7	8	0,17	0,2	0,25	0,25	0,33	0,5	1	1	2	0,13	0,14	0,17	4	5	6	1	1	2	1	1	2
PB17 Product Attributes	0,5	1	1	0,13	0,14	0,17	1	1	2	1	1	2	0,17	0,33	0,5	0,25	0,33	0,5	0,13	0,14	0,17	0,13	0,14	0,17	1	1	2	0,13	0,14	0,17	0,17	0,2	0,25
PB26 Logistics Benefits	0,5	1	1	0,13	0,14	0,17	0,5	1	1	1	1	2	0,13	0,14	0,17	0,13	0,14	0,17	0,13	0,14	0,17	0,11	0,11	0,13	0,17	0,2	0,25	0,13	0,14	0,17	0,17	0,2	0,25
PB28 Strategic Benefits	6	7	8	4	5	6	6	7	8	6	7	8	1	1	2	2	3	4	1	1	2	0,17	0,2	0,25	4	5	6	2	3	4	1	1	2
PB29 Financial benefits	4	5	6	2	3	4	6	7	8	6	7	8	0,25	0,33	0,5	1	1	2	0,17	0,2	0,25	0,13	0,14	0,17	1	1	2	0,17	0,2	0,25	1	1	2
PB43 Product Customization	6	7	8	0,5	1	1	6	7	8	6	7	8	0,5	1	1	4	5	6	1	1	2	0,17	0,2	0,25	4	5	6	1	1	2	1	1	2
PB46 Reliability	6	7	8	4	5	6	6	7	8	8	9	9	4	5	6	6	7	8	4	5	6	1	1	2	6	7	8	4	5	6	4	5	6
PB47 Technical Competence	0,5	1	1	0,17	0,2	0,25	0,5	1	1	4	5	6	0,17	0,2	0,25	0,5	1	1	0,17	0,2	0,25	0,13	0,14	0,17	1	1	2	0,17	0,2	0,25	0,5	1	1
PB49 Trust	6	7	8	0,5	1	1	6	7	8	6	7	8	0,25	0,33	0,5	4	5	6	0,5	1	1	0,17	0,2	0,25	4	5	6	1	1	2	0,17	0,2	0,25
PS22 Price	4	5	6	0,5	1	1	4	5	6	4	5	6	0,5	1	1	0,5	1	1	0,5	1	1	0,17	0,2	0,25	4	5	6	4	5	6	1	1	2

The authors had then to go through the evaluation criteria obtained by multiplying the matrix $\mathbf{M_{PBDL}}$ Table 4 by applying eq3-10) obtained by the weights of each alternative (PB/PS) with respect to main criteria (deliverables) with the normalized vector obtained by the weights of the criteria (eq10) $\mathbf{W_{DL}}^{\mathbf{T}}$. The summary of the results of the fuzzy comparison of each PB/PS to each deliverables was a matrix and thus the resulting of the final score (SC) for the alternatives (PB/PS) is given by the $\mathbf{SC = M_{PBDL} \times W_{DL}^{T}}$ (Figure 7).

Table 4. Matrix MPBDL: Importance weightings, of all alternatives, with respect to each deliverable

	DL2	DL3	DL4	DL5
PB2	0,21	0	0	0
PB4	0	0,06	0,24	0,21
PB17	0,03	0	0,24	0,04
PB26	0	0	0	0
PB28	0,22	0,17	0	0
PB29	0,18	0	0	0
PB43	0	0,09	0	0,11
PB46	0,37	0,55	0,27	0,34
PB47	0	0	0,25	0,3
PB49	0	0,11	0	0
PS22	0	0,02	0	0

$$SC = \begin{bmatrix} 0{,}206 & 0 & 0 & 0 \\ 0 & 0{,}064 & 0{,}243 & 0{,}214 \\ 0{,}027 & 0 & 0{,}243 & 0{,}041 \\ 0 & 0 & 0 & 0 \\ 0{,}219 & 0{,}172 & 0 & 0 \\ 0{,}183 & 0 & 0 & 0 \\ 0 & 0{,}093 & 0 & 0{,}109 \\ 0{,}365 & 0{,}549 & 0{,}27 & 0{,}34 \\ 0 & 0 & 0{,}245 & 0{,}296 \\ 0 & 0{,}106 & 0 & 0 \\ 0 & 0{,}016 & 0 & 0 \end{bmatrix} \times \begin{bmatrix} 0{,}1949 \\ 0{,}4025 \\ 0 \\ 0{,}4025 \end{bmatrix} = \begin{bmatrix} 0{,}04014 \\ 0{,}11186 \\ 0{,}02173 \\ 0 \\ 0{,}11203 \\ 0{,}03559 \\ 0{,}08135 \\ 0{,}42888 \\ 0{,}11911 \\ 0{,}04261 \\ 0{,}00662 \end{bmatrix}$$

Fig. 7. Final score (SC) for alternatives (PB/PS)

The overall result integrating the client perspective is presented in the Table 5, giving us: a) the priority weights of each deliverable as well as their correspondence to each endogenous/exogenous or used/built assets; b) the priority weights of each PB/PS; c) and the relationship between the deliverables and PB/PS.

Relative importance between each Criterion (deliverables)

Based on the overall composite value in Table 5, we can comment the priority weights of each criterion:

"Requirements for new collection" (DL3) and "Product Innovation" (DL5) are the best ranked deliverable (criteria) with 0,403 followed by the "Product Information" (DL2) with 0,195. The interview testimonial of the client, confirm the rational for those relationships:

> *(…) the enterprise has a huge assortment of products and they innovate constantly for each season (related with DL5) . This implies, we don't need to develop a specific product, for example a new textile or new soles. Also we have reliability on this enterprise, since they have certified products reflecting in their service quality and in their technical competence. (…)"(Client interview excerpts).*
>
> *"(…) When we think in DL3, we related this component with the fact we can take the product catalogues with us and with it we can more easily create our collection (…)." (Client interview excerpts).*

The deliverable "Knowledge and Experience about the process" (DL4) is irrelevant for this client, because this deliverable is embedded in DL3, and this zero make sense according to the interview at the client:

> *"(...) I know very little about the raw material. For example, we don't know if fabrics are with good quality, i.e, if they had the U.E. tests, if it is possible to make a detail in a certain product without having the risk of the fabric doesn't rip, etc. In this context, we depend on the reliability that we have on the company and with their technical competence to advise us of those characteristics. I think this is more related with DL3" (Client interview excerpts).*

Table 5. Final results, integrating of the Client perception

		PB2 Product Quality	PB4 Service Quality	PB17 Product Attributes	PB26 Logistics Benefits	PB28 Strategic Benefits	PB29 Financial benefits	PB43 Product Customization	PB46 Reliability	PB47 Technical Competence	PB49 Trust	PS22 Price	Weight priority (WDLT) vector of the assets
A02 [Uses]Know-how; A22[Builds] Sales per Customer;A27[Builds]Percent of Satisfaction;A29 [Uses]Certified Products	DL2-Product Information	0,206	0,000	0,027	0,000	0,219	0,183	0,000	0,365	0,000	0,000	0,000	0,195
A02 [Uses]Know-how; A27[Builds]Percent of Satisfaction; A28[Builds]Percent of Customer Orders; A11 – [Uses] Years of experience;	DL3- Requirements for new collections	0,000	0,064	0,000	0,000	0,172	0,000	0,093	0,549	0,000	0,106	0,016	0,403
A11 – [Uses] Years of experience;	DL4-Knowledge and experience about the process	0,000	0,243	0,243	0,000	0,000	0,000	0,000	0,270	0,245	0,000	0,000	0,000
A27[Builds]Percent of Satisfaction;A11 – [Uses] Years of experience; A22[Builds] Sales per Customer; A16 [Build]Competitiveness	DL5- Product Innovation	0,000	0,214	0,041	0,000	0,000	0,000	0,109	0,340	0,296	0,000	0,000	0,403
	Weight priority (WPB) vector of the PB	0,040	0,112	0,022	0,000	0,112	0,036	0,081	0,429	0,119	0,043	0,007	

Relative importance between each Alternatives (PB/PS)

Making now the bridge to the perceived benefits, and based on the overall composite value in Table 5**,** we can comment the priority weights of each alternative.

The alternative "Reliability" (PB46), with 0,429, scored the highest priority according to the other PB/PS, followed by the "Technical Competence" (PB47) with 0,119 and "Strategic Benefits"(PB28) with 0,112. "Reliability" also scored the highest degree of relevance on "Requirements for new collection" (DL3) with 0,549, "Product Innovation" (DL5) with 0,340 and in "Product Information" (DL2) with 0,365. Therefore, "Reliability" will be chosen the most relevant perceived benefit among the set of the alternatives.

The "Technical Competence" (PB47) was in second rank on the client perspective, having the highest value in the "Product Innovation" (DL5). And this makes sense as PB47 "captures the creativity of the supplier's stuff" (Lapierre, 2001 p 256), by the development of new products. Also by providing knowledge and experience about the process (DL4) they "demonstrate comprehensive process knowledge of the client's business" (Lapierre, 2001 p 256). According to Table 1, the enterprise perspective did not value this perceived benefit (PB47), since:

> *"(…) in our perspective the client should not value the technical competence, because we do not produce the raw material" (enterprise interview excerpts)".*

Although, the client said:

> *"(…) we know they don't produce, but the value becomes from the enterprise understand our requirements and their expertise in the client activity sector, namely how to develop new materials with good quality"(client interview excerpts)."*

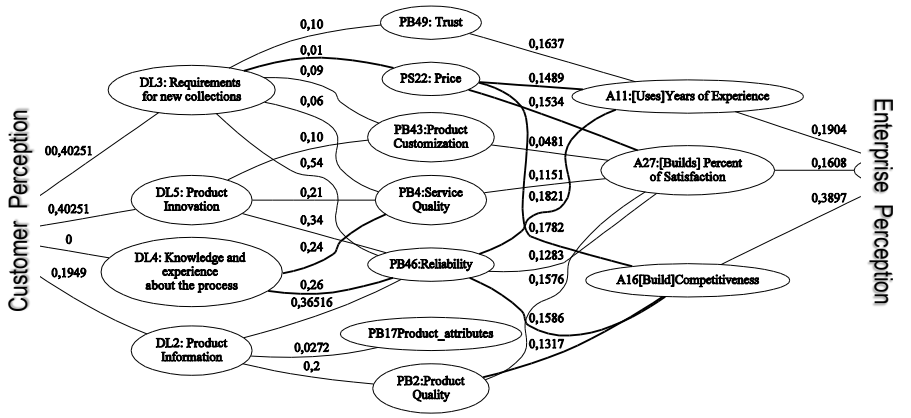
It is worthy to note that among the 11 alternatives the "Strategic Benefits" (PB28) and "Service Quality" (PB4) are ranked very close with 0,112 and 0,1118 respectively. This reveals that these two alternatives are almost equally important in the perception on the client. The PB28 shows the highest degree of relevance when related to "Product Information" (DL2), and PB4 shows the highest degree of relevance when related to "Knowledge and Experience about the process" (DL4).

It is interesting to observe that "Price" (PS22) is not relevant for this client. It is clear that clients do not buy solely based on price. They buy the trade-off between the benefits a client receives from a product and what he pays for it. Intuitively, the client may think on price, but when evaluating the overall alternatives the price is not the most relevant alternative.

5.4 Discussion of the results

Figure 8 builds the bridge between the items delivered to the Client, the Deliverables, and the enterprise Assets used/build by PONTECHEM to respond to and meet the client needs. The point we want to make at an Ex-Ante analysis is how relevant this exercise was for Pontechem in understanding of how their Value Proposition is seen by the client. This picture builds a most relevant connection between deliverables, whose value is perceived (or not, as we have seen) by the client and the supporting enterprise endogenous or exogenous assets, enabling therefore a better understanding of how to adjust the Value Proposition and the supporting enterprise assets perceived as relevant.

There were not sizeable differences between the enterprise and client perception. From the evaluation of the two perspectives the alternative with higher value was Reliability (PB46). It is worth noting that the quantitative method provided new relevant relations between perceived benefits/sacrifices (PBs/PSs) and exogenous and exogenous assets. As an example from the enterprise perspective, we have "Reliability" (PB46) that emerged strongly as related with [Uses] years of experience (A11) and [Builds] Competitiveness (A16).



Legend: Bold lines were not mentioned in the interview. These connections emerged upon the pair-wise comparison of the different criteria/alternatives.

Fig. 8. The integration of Pontechem and Customer perspectives

Regarding the endogenous/exogenous assets that were analyzed in the company, some connections emerged after the evaluation of 11 alternatives, which were not mentioned in the interview. As an example, "Reliability" (PB46) emerged in the assets [Builds] Competitiveness (A16) and in [Uses] Years of experience (A11). According to literature review, this represents the reality, "the enterprise must always be aware of the reliability level" (Theotokas,1999 p4) by [using] theirs years of experience (A11) contributing to "perform the promised service dependably and accurately" (Lapierre 2000, p255). Also, with the continuous scanning in searching new products ("Product Innovation" (DL5)) they contribute for the improvement of the competitiveness/reliability relation ([Building] Competitiveness). Indeed, according to the Theotokas "competition is based on the ability of the enterprise to provide high reliability" (Theotokas, 1999, p2). The interview testimonial of the client and enterprise perception, confirm the rational for those relationships:

> *" (…) if we want a specific development of new textile material, we have the reliability on the Pontechem to develop the new material. In this sense we expected also the U.E. tests applied in the new material and with the*

efficiency that results from their years of experience." (Client interview excerpts)

"(…) with our years of experience the possibility to fail is very low." (Enterprise interview excerpts).

Also, "Reliability" (PB46) and "Product Quality" (PB2) emerges with a logical connection in the asset [Builds] Competitiveness (A16), relating with the accuracy of the transaction.

"(…) when we promise a solution for their problems we must do it right at first time (reliability) to guarantee our success. Also we have a European supplier the U.E tests are covered on the raw material. We have these conditions in relation to other enterprises. This gives us some competitiveness. We have no records of any material being delivered and classified as not complying with the requirements. The client have these guaranties, and therefore, they relate also, competitiveness with product quality "(enterprise interview excerpts)

The Price (P22) emerges in [Uses] Years of experience (A11) and in [Builds] Competitiveness (A16), because price is "always a part of the customer's value calculation" (Lapierre, 2001 p259).

"(…) the years of experience gave us technical knowledge which allowed us nulling certain costs that will be reflected in the price of the final product (…)."(enterprise interview excerpts).

Also, the perceived benefit, Price (P22) emerge in [Build] Percent of satisfaction (A27), because the enterprise must "adapt to customer needs and must set price with regard for the customer" (Lapierre, 2000 p259):

" (…) in fact, the client knows we do not practice prices outside the market. We present prices, which represents the client satisfaction. We offer a good price, not the cheapest. It is a fair price. Also, we show solutions for their requirements (e.g new materials), that are not excessive in cost." (enterprise interview excerpts)

On the other hand and building the bridge to the client perception of the deliverables, the Pontechem CEO and his team responsible for Purchasing/Sales & Operations Planning, were able to understand how clients saw the most important deliverables, and how they correlate with PBs. As an example, the client did not value deliverable "Knowledge and Experience about the process" (DL4) (Figure 8), however, the client "reads" this deliverable as embedded in DL3 "Requirements for new collections". The Pontechem CEO and the responsible of Purchasing/Sales & Operations Planning and taking into account the characteristics of the client, explained:

"(…) the client knows very little about the products. But indeed they relate with "Technical Competence" (PB47) and "Reliability" (PB46) and also "Service Quality" (PB4). We think the client did not value this deliverable, because he doesn't negotiate with the supplier" (enterprise interview excerpts)

Making the zoom on the Figure 8, on "Knowledge and Experience about the process" (DL4), a new logical connection emerges with "Service Quality" (PB4) Figure 9.

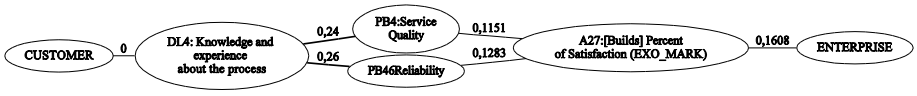


Fig. 9. Zoom on DL4 ("Knowledge and Experience about the process")

According to the literature, the definition on service quality, relates to the procedures by the enterprise in two dimensions: technical and functional, (Grubor et al.). At a

functional dimension includes an assessment of how well a delivered service conforms to the client´s expectations, namely uses, receives, and pays perceived for a certain service and all aspects of a service delivery process. At the technical dimension the client perceives and understands how the enterprise identifies problems to better assess client satisfaction. In this context, it is the enterprise role to assist clients and provide immediate services by informing, giving the knowledge and expertise required to provide the service.

> *"(…) the functional dimension is related with the sales, orders, bills. The technical dimension it also when the client have some doubts and ask for the prototypes that are not included in the collection and wait for an answer. (…)" (enterprise interview excerpts)*

"Requirements for new collection" (DL3) and "Product Innovation" (DL5) have the same value to the client. The DL3 is defined, as the possibility of taking the samples to the client, and suggestions for some changes in the products.

> *"(…) It is obvious this deliverable (DL3) emerge with price. When there is a new collection or another specific requirement, there is a new table of prices. Sometimes the client wants to personalize the material. If the client wants the shoes to go to the market at a 20 € and we have a product a 30€ linear meter, the client must do the calculation to verify if it matches. That's why the DL3 is related with Product Customization (PB43)." (enterprise interview excerpts)*

As a final conclusion of this work, the authors highlighted the following comments from the enterprise:

> *"(…) When we look at this scheme without looking at our suppliers what we can achieve and what we can adjust in case of failure, may be related to the quality service and the reliability. In Pontechem we only buy and sell materials. If the customers feel dissatisfied with something, this model came to help clarify the points where we can focus on to reduce this dissatisfaction. We can work on service quality, reliability and without doubt in trust that appears with lower values because it is related to reliability. Have no influence on the product because we are not the producer. The characteristics of the products are not connected to us. The reliability and quality of service is related to us. In price can make small adjustments. (…)" (enterprise interview excerpts)*

As a final result we were finally able to respond to the 2nd research question, "*Can we derive a formal mathematical model that provides for the quantitative handling of the proposed model?"* Figure 8 shows how these quantitative relations emerge and the interviews further validated and stressed the uncovered dependencies.

6 Limitations of the Research and Benefits to Managers

The research team performed this study by following clear methodological approach. However, some limitations have emerged and they should be acknowledged and addressed regarding the quantitative model present study:

- As a main limitation we would highlight the fact that people find that it is hard and subjective to assess the pair-wise comparisons using the Saaty scale. In this study the problem was overcome by having interviews with the involved persons, both at the target enterprise and with their client to understand how their endogenous and exogenous assets contribute to that perception. This has enabled a further assessment of how reasonable and logic the achieved results were. This approach as well as the discussions of the outcomes with all parties involved,

allowed the collection of testimonials that helped the validation of the proposed model.

- The fact that we have only one customer is not the best scenario, as it only reflects one opinion. However, the usage of the triangular fuzzy numbers enables the introduction of the uncertainty of this only opinion in the process, thus enabling the method application. To this end we followed the method proposed by (Chen, 2004a, Chang, 1996). This restriction results from limitations imposed in all our case studies where the company is usually reluctant in allowing interviews and long questionnaires with the customers/clients.

Regarding the Theoretical Model, the Conceptual Model for Decomposing Value For the Customer, we would highlight, as the main limitation, the difficulty people at the enterprise had in the interpretation of the graph in Figure 8. This result was only understood after some explanation that the numbers in those connections only represent the strength of the relationship between two variables. We would suggest that in the future we could use colour scales to paint the lines in order to make this analysis more intuitive.

As main benefits of this exercise for a micro enterprise as this one, we would highlight that this tool may be useful to help these companies in the generation of an internal discussion of how their offer is perceived by their clients. In this case study it was interesting to realize that some unexpected variables emerged as being more relevant that initially thought. From the management perspective this brought up the awareness on those issues that may now be looked upon in a new way. This tool may, therefore, be a useful instrument in supporting the commercialisation of new products and/or services.

7 Conclusion and Avenues for Future Research

This research builds on the different dimensions of the value creation analysis comprising the asset utilization, value conversion, value enhancements, the transaction's perceived value and the social value. The authors are aware that members of the organization may have different understanding of the perceived value of the enterprise offer. Time also has a direct impact in the perceived value, from the pre-purchase to the post-purchase phases. In this research, we proposed a Conceptual Model Decomposing Value for the Customer, combining several concepts, from the marketing area we have the concept of Value for the Customer, from the collaborative networks area we have the perspective of the enterprise life-cycle and the environment characteristics and from the intellectual capital area we have the concept of the value networks. This research proposed a quantitative model for the Value for the Customer that was applied in a case study of an enterprise in footwear industry (Pontechem) aiming at understanding the components of its Value Proposition. The case study allowed the validation of the proposed model constructs and their relations. Interview testimonials enabled the validation of the answers to the 1st research questions. The quantitative model was then derived and the final results computed into a matrix representing the degree of relevance among pairs of assets/Perceived Benefits. This was done independently both from the enterprise and the client perspective, thus enabling the connection between endogenous and exogenous assets and perceived benefits and sacrifices, which, in its turn enabled the response to the 2nd research question. Interviews and further literature were used to validate the achieved results.

Finally, we would add that the merits of this approach seem evident from the contact with the Pontechem as it provides a structured approach for enterprises to know and understand the customer needs and how these relate to their endogenous and/or

exogenous assets, therefore enabling the better adequacy of their value proposition.

> *"Looking to these results it was very interesting making this analysis. This model clarifies some points, where we could focus to improve client satisfaction."*

This enterprise knows very well their client's needs. The results revealed common findings related with the relevance of each exchanged deliverables. The most relevant deliverable from both perspectives was "Product innovation". As stated in the final interview:

> *"(…) the model and the quantitative method becomes useful for the company, we had never realize how the technical competence was linked with the DL5 and DL4. It is good to know, we are well prepared for the technical challenges in innovation" (enterprise interview excerpts)*

This novel proposed approach revealed its usefulness by uncovering disregarded connections between assets used and/or built in the foreseen exchange of deliverables and perceived benefits/sacrifices in the context of the enterprise offer value proposition, thus allowing the enterprise further discussion about these issues.

The unfolding of this research shows that this is a useful exercise for SMEs if they want to assess the value proposition of their offer and, moreover, if they want to understand the adequacy of their enterprise assets to supporting the desired value proposition. This case study as well as the previous one's, revealed that awareness increases on issues that were previously disregarded. As future research we foresee the development of a tool for Micro companies and SMEs, which would allow users in the enterprise to build a model combining both the internal and the perspective of their clients.

Acknowledgements

The authors would like to acknowledge Pontechem, as well as the people that were interviewed, namely José Maria Bezerra (Pontechem CEO) and Joana Bezerra (Purchasing/Sales & Operations Planning) for their, patience, support and assistance on this research. Acknowledgements is also due for making their advice and expertise available to the research team. Their willingness to give their time so generously has been very much appreciated. The authors would further like to acknowledge the two anonymous reviewers for their invaluable contributions.

8 References

Aggarwal, R. & Singh, S. (2013). AHP and Extent Fuzzy AHP Approach for Prioritization of Performance Measurement Attributes. *World Academy of Science, Engineering and Technology,* 73**,** 145-151

Ahmad, N., Berg, D. & Simons, G. R. (2006). The Integration of Analytical Hierarchy Process and Data Envelopment Analysis in a Multi-Criteria Decision- Making Problem. *International Journal of Information Technology & Decision Making* 5**,** 263-276

Ahmad, N. & Laplante, P. A. (2009). Using the Analytical Hierarchy Process in Selecting Commercial Real-Time Operating Systems. *International Journal of Information Technology & Decision Making,* 8**,** 151-168

Allee, V. (2000a). Reconfiguring the value network. *Journal of Business strategy,* 21**,** 36-39

Allee, V. (2000b). The value evolution: addressing larger implications of an intellectual capital and intangibles perspective. *Journal of intellectual capital,* 1**,**

17-32

Allee, V. (2002a). A Value Network Approach for Modeling and Measuring Intangibles. *Presented at Transparent Enterprise, Madrid, November*

Allee, V. (2002b). A value network approach for modeling and measuring intangibles. *Proceedings Transparent Enterprise, Madrid*

Allee, V. (2008a). "Value Network Analysis and Value Conversion of Tangible and Intangible Assets." 9**,** 5-24

Apiccaps. (2008). *Footure 2015* [Online]. http://www.apiccaps.pt/web/guest/home

BdP (2012) *Análise Setorial da Indústria do Calçado, BANCO DE PORTUGAL - Estudos da Central de Balanços* - Edição do Departamento de Estatística, Novembro 2012, ISSN 1647-9688

Blocker, C. P. & Flint, D. J. (2007). Exploring the dynamics of customer value in cross-cultural business relationships. *Journal of Business & Industrial Marketing,* 22**,** 249-259

Camarinha-Matos, L.M. & Afasarmanesh, H. (2008a). Collaborative Networks: Reference Modeling. *Springer Science+Business Media, LCC*

Camarinha-Matos, L.M. & Afasarmanesh, H. (2008b). Arcon Reference Models for Collaborative Networks. . *Collaborative Networks: Reference Modeling,* 83-112

Chang, D.-Y. (1996). Applications of the extent analysis method on fuzzy AHP. *European Journal of Operational Research,* 95**,** 649-655

Chen, H. (2004a). *A research based on fuzzy AHP for multi-criteria supplier selection in supply chain*. Master, University of Science and Technology

Chen, H. (2004b). *A research based on fuzzy AHP for multicriteria supplier selection in supply chain*. . Master thesis, University of Science and technology

Chen, M.-F., Tzeng, G. H. & Tang, T.-I. (2005). Fuzzy Mcdm Approach For Evaluation Of Expatriate Assignments. *International Journal of Information Technology & Decision Making,* 4**,** 277-296

Costa, E. & Ferreira, J. J. P. (2012). A reference model perspective for conventional business narrative analysis: An essay on an entrepreneurial narrative. *African Journal of Business Management,* 6**,** 8199-8219

De Toni, A. & Tonchia, S. (2003). Strategic planning and firms' competencies: traditional approaches and new perspectives. *International Journal of Operations & Production Management,* 23**,** 947-976

Deng, H. (1999). Multicriteria analysis with fuzzy pairwise comparison. *International Journal of Approximate Reasoning,* 21**,** 215-231

Dubé, L. & Paré, G. (2003). Rigor in information systems positivist case research: current practices, trends, and recommendations. *Mis Quarterly***,** 597-636

Eisenhardt, K. M. & Graebner, M. E. (2007). Theory building from cases: opportunities and challenges. *Academy of Management Journal,* 50**,** 25-32

Ertuğrul, İ. & Karakaşoğlu, N. (2008). Comparison of fuzzy AHP and fuzzy TOPSIS methods for facility location selection. *The International Journal of Advanced Manufacturing Technology,* 39**,** 783-795

Flint, D. J., Woodruff, R. B. & Gardial, S. F. (1997). Customer value change in industrial marketing relationships - A call for new strategies and research. *Industrial Marketing Management,* 26**,** 163-175

Flint, D. J., Woodruff, R. B. & Gardial, S. F. (2002). Exploring the phenomenon of customers' desired value change in a business-to-business context. *Journal of Marketing,* 66**,** 102-117

Fu, G. L., Yang, C. & Tzeng, G. H. (2007). A Multicriteria Analysis on the Strategies to Open Taiwan's Mobile Virtual Network Operators Services. *International Journal of Information Technology & Decision Making (IJITDM)* 6**,** 85-112

Grönroos, C. (2008). Service logic revisited: who creates value? And who co-creates? *European Business Review,* 20**,** 298-314

Grubor, A., Salai, S. & Leković, B. (2009) Service Quality As a Factor of Marketing Competitiveness Web site: www.asecu.gr/files/RomaniaProceedings/29.pdf

Herrera Umaña, M. F. & Osorio Gómez, J. C. (2006). Modelo para la gestión de proveedores utilizando AHP difuso. *Estudios Gerenciales,* 22**,** 69-88

Hevner, A. R., March, S. T., Park, J. & Ram, S. (2004). Design science in information systems research. *MIS Q.,* 28**,** 75-105

Holbrook, M. (1994). Ethics in consumer research: An overview and prospectus. *Advances in consumer research,* 21**,** 566-566

Huber, J., J. Lynch & AL, E. (1997). Thinking About Values in Prospect and Retrospect: Maximising Experience Utility. *Marketing Letters,* 8**,** 323-334

Institute., M. S. (2010). Retrieved March 27, 2012, from 2010-2012 research priorities-12.pdf Web site: http://www.msi.org/pdf/MSI_RP10

Jalili, M. & Rezaie, K. (2010). Quality principles deployment to achieve strategic results. *International Journal of Business Excellence,* 3**,** 226-259

Komulainen, H., Mainela, T., Tähtinen, J. & Parhi, P. Expected, realized and potential value in a new service setting. Proceedings of the 21st Annual IMP Conference, Rotterdam, Netherlands, 1-3 September, (2005). Sage, 1-19

Komulainen, H., Mainela, T., Tähtinen, J. & Ulkuniemi, P. (2007). Retailers' different value perceptions of mobile advertising service. *International Journal of Service Industry Management,* 18**,** 368-393

Kothandaraman, P. & Wilson, D. T. (2001). The future of competition: value-creating networks. *Industrial Marketing Management,* 30**,** 379-389

Kowalkowski, C. (2011). Dynamics of value propositions: insights from service-dominant logic. *European Journal of Marketing,* 45**,** 277-294

LAI, A. W. (1995). Consumer Values, Product Benefits and Customer Value: A Consumption Behavior Approach. *Academic Journal,* 22**,** 381

Lapierre, J. (2000). Customer-perceived value in industrial contexts. . *Journal of Business & Industrial Marketing, MCB UP Ltd.,* 15 122-140

LAPIERRE, J. (2001). Development of measures to assess customer perceived value in a business-to-business context. *Advances in Business Marketing and Purchasing,* 243-286

LUSA (2012). Portugal tem cinco por cento das microempresas da UE 16-01-2012 ed. CONFAGRI

Nicola, S., Pinto Ferreira, E. & Pinto Ferreira, J. J. Value Model For Supporting Negotiation In Collaborative Networks. *In:* Isaías, P. K. A. P., ed. IADIS - International Conference, (2010). 474-478

Nicola, S., Pinto Ferreira, E. & Pinto Ferreira, J. J. (2012). A Novel Framework For Modelling Value For The Customer, An Essay On Negotiation. *International Journal of Information Technology & Decision Making*

Nukala, S. & Gupta, S. M. A fuzzy AHP based approach for selecting potential recovery facilities in a closed-loop supply chain. Proceedings of the SPIE International Conference on Environmentally Conscious Manufacturing V,

Boston, Massachusetts, (2005). 58-63

Oliveira, M. A.-Y. & Pinto Ferreira, J. J. (2011). Facilitating qualitative research in business studies: Using the business narrative to model value creation,. *African Journal of Business Management Decision,* 5**,** 68-75

Osterwalder, A. (2004). The business model ontology: A proposition in a design science approach. *Institut d'Informatique et Organisation. Lausanne, Switzerland, University of Lausanne, Ecole des Hautes Etudes Commerciales HEC,* 173

Osterwalder, A. & Pigneur, Y. (2010). Business Model Generation: A handbook for visioneries, game changers, and challengers. John Wiley & Sons

Parasuraman, A. (1997). Reflections on gaining competitive advantage through customer value. *Journal of the Academy of Marketing Science,* 25**,** 154-161

Peng, Y., Kou, G., Wang, G., Wu, W. & Shi, Y. (2011). Ensemble of software defect predictors: an AHP-based evaluation method. *International Journal of Information Technology & Decision Making,* 10**,** 187-206

Pentland, B. T. (1999). Building process theory with narrative: From description to explanation. *Academy of management review,* 24**,** 711-724

Rahikka, E., Ulkuniemi, P. & Pekkarinen, S. (2011). Developing the value perception of the business customer through service modularity. *Journal of Business & Industrial Marketing,* 26**,** 357-367

Rhodes, C. & BrowN, A. D. (2005). Narrative, organizations and research. *International Journal of Management Reviews,* 7**,** 167-188

Saaty, T. L. (1990). How to make a decision: The Analytic Hierarchy Process. *European Journal of Operational Research,* 48**,** 9-26

Santos, A. S. (2014). Empresas vão pagar taxas de 19% em 2018. *Jornal Expresso*. Economia

Santos Pereira, S. (2013). Exportações: Empresas de calçado antecipam subida das vendas em 2013 *Económico*

Simpson, P. M., Siguaw, J. A. & Baker, T. L. (2001). A model of value creation: Supplier behaviors and their impact on reseller-perceived value. *Industrial Marketing Management,* 30**,** 119-134

Smith, J. B. & Colgate, M. (2007). Customer value creation: a practical framework. *The journal of marketing theory and practice,* 15**,** 7-23

Ulaga, W. (2003). Capturing value creation in business relationships: A customer perspective. *Industrial Marketing Management,* 32**,** 677-693

Ulaga, W. & Eggert, A. (2006). Relationship value and relationship quality: Broadening the nomological network of business-to-business relationships. *European Journal of Marketing,* 40**,** 311-327

Uschold, M., King, M., Moralee, S. & Zorgios, Y. (1998). The Enterprise Ontology. *Knowl. Eng. Rev.,* 13**,** 31-89

Vahidnia, M., Alesheikh, A., Alimohammadi, A. & Bassiri, A. (2008). Fuzzy analytical hierarchy process in GIS application. *The International Archives of the Photogrammetry, Remote Sensing and Spatial Information Sciences,* 37**,** 593-596

Vargo, S. L. & Lusch, R. F. (2004). Evolving to a new dominant logic for marketing. *Journal of Marketing,* 68**,** 1-17

Wang, Y.-M., Luo, Y. & Hua, Z. (2008). On the extent analysis method for fuzzy AHP and its applications. *European Journal of Operational Research,* 186**,** 735-747

Woodall, T. (2003). "Conceptualising Value for the Customer: an Attributional, Structural And Dispositional Analysis". *Academy of Marketing Science Review*., 12

Woodruff, R. (1997). "Customer Value: The Next Source for Competitive Advantage." *Journal of the Academy of Marketing Science*., 25**,** 139-153

Woodruff, R. B. & Flint, D. J. (2006). Marketing's service-dominant logic and customer value. *The service-dominant logic of marketing: Dialog, debate, and directions***,** 183-195

Zeithaml, V. A. (1988). Consumer perceptions of price, quality, and value: A means-end model and synthesis of evidence. *Journal of Marketing,* 52**,** 2-22

Annex A1

Table A.1. Perceived Benefits/Sacrifices

Deliverables	Assets Use/Build	Perceived Benefits/Sacrifices
DL2 - Product Information	A29[Uses]Certified Products (EXO_SUP)	PB21 Utility PB29 Financial Benefits
	A22[Builds]Sales per customer (END_FUNC)(EXO_MARK)	PB2 Product Quality PB47 Technical Competence PB49 Trust PS3 Monetary Costs PS22 Price
	A27[Builds]Percent of Satisfaction (EXO_MARK)	PB2 Product Quality PB4 Service Quality PB46 Reliability PB43 Product Customization PB17 Product Attributes
	A11[Uses]Years of Experience (EXO_SUP)(END_FUNC)	PB49 Trust
	A2 [Uses]Know-how	PB49 Trust
DL3 - Requirements for new collections	A27[Builds]Percent of Satisfaction (EXO_MARK)	PB2 Product Quality PB4 Service Quality PB46 Reliability PB43 Product Customization PB17 Product Attributes
	A28[Builds]Percent of Customer Orders (EXO_MARK)(EXO_SUP)	PB21 Utility PB33 Convenience PB45 Flexibility
	A11[Uses]Years of Experience (EXO_SUP)(END_FUNC)	PB47 Technical Competence PB49 Trust
	A2[Uses] Know-how (END_S	PB47 Technical Competence PB49 Trust
DL4 - Knowledge and experience about the process	A11[Uses]Years of Experience (EXO_SUP)(END_FUNC)	PB47 Technical Competence PB49 Trust
DL5 - Product Innovation	A27[Builds]Percent of Satisfaction (EXO_MARK)	PB2 Product Quality PB4 Service Quality PB46 Reliability PB43 Product Customization PB17 Product Attributes
	A22[Builds]Sales per customer	PB2 Product Quality PB47 Technical Competence PB49 Trust PS3 Monetary Costs PS2 Price PB47 Technical Competence
	A11[Uses]Years of Experience	PB49 Trust
	A16[Build]Competitiveness (EXO_MARK)	PB26 Logistic Benefits PB29 Financial Benefits
DL12 - Communication of specific cases	A20[Uses]Knowledge Reuse (END_ST)	PB43 Product Customization
DL13 - Research on new design and models (suppliers)	A28[Builds]Percent of Customer Orders (EXO_MARK)(EXO_SUP)	PB21 Utility PB29 Financial Benefits PB28 Strategic Benefits