



Chair:
Prof. Mariano Corso

DOCTORAL PROGRAM IN MANAGEMENT, ECONOMICS AND INDUSTRIAL ENGINEERING

The Doctoral Program in Management, Economics and Industrial Engineering (DRIG) provides students with advanced education and the opportunity to do research activity in these scientific fields. The program allows candidates to build a solid methodological background, and it fosters the development of multi-disciplinary knowledge, an open minded approach to research activities, and the ability to address problems in an innovative way, while combining different perspectives and approaches.

The program is taught in English. It is composed of three different types of training activities.

Main courses include:

- methodological courses relating to aspects relevant to research in management, economics and industrial engineering;
- thematic courses whose aim is to introduce students in state-of-the-art research in specific fields relating to the above mentioned disciplines: Business strategy, Organization & human resources, Finance, Economics and management of innovation, Industrial Organization, International economics, Regional and urban economics, Supply chain management, Operations, Facility management, Logistics and others.

Elective courses and training in specific themes

these activities are customized according to the specific research interests of students. Their aim is to extend the scientific knowledge of students in specific topics and to introduce them to the international research community through the presentation of research work in international conferences.

Thesis

This is the core of the program. Students are expected to develop state-of-the-art research competencies on an issue relevant to the scientific debate and to produce an original contribution that extends the available scientific knowledge on this issue.

The doctoral program covers three years. Students are required to spend at least one semester in a foreign research institution. The Department of Management, Economics and Industrial Engineering is qualified as hosting institution of the PRIME Network of Excellence established by the European Commission within the 6th Framework program. Hence students have access to the mobility support measures aimed at promoting international collaboration between the doctoral programs in the network. In addition, students are encouraged to attend doctoral schools and workshops organized by other institutions and to participate in international scientific conferences. Presentation of an original research work in an international conference is mandatory for admission to the final exam.

In previous years, students have been hosted by well known foreign academic institutions such as CRIC-University of Manchester, SPRU-University of Sussex, University of Reading, University of Nottingham, London Business School, Trinity College Dublin, Université Henri Poincaré Nancy, Georgia Institute of Technology, New York University, École polytechnique fédérale de Lausanne, Imperial College London, Ecole des hautes études commerciales de Paris (HEC), Cranfield University, University of Warwick, Chalmers University Göteborg, ETH Zurich, Harvard Business School, Columbia University, MIT, UCLA and others.

The Faculty of DRIG includes, in addition to professors of the Department of Management, Economics and Industrial Engineering of Politecnico di Milano, several foreign professors: Adolfo Arata, Universidad Tecnica Federico Santa Maria, Valparaiso, Chile; Neil Gandal, Tel Aviv University, Israel; Benoit lung, Université Henri Poincaré, Nancy, France; Bertrand Quélin, HEC-Paris; Tereza Tykova, Zew, Germany; Mike Wright, University of Nottingham, UK; Frank Rothaermel, Georgia Institute of Technology, GA, USA; Irvine Lapsley, University of Edinburgh, UK; Bruno Cassiman, IESE Business School, Spain; Alan MacCormack, Harvard Business School, MA, USA; Dirk Czamitzky, University of Leuven, Belgium; Erik Hultink, Delft University of Technology, The Netherlands; Christopher Lettl, Aarhus School of Business, Denmark; Christopher Worley, University of Southern California, CA, USA; David Coghlan,

Trinity College Dublin; Stephen Tallman, University of Richmond, VA, USA.

The program has developed several research collaborations with private manufacturing and service firms, regulatory bodies, and other public research institutions: Value Partners, TXT e-solutions, D'Appolonia, Consorzio MIP, Fondazione Rosselli, Consorzio Politecnico Innovazione, IRER, Società Banknord GE.PA.FI. SIM, Siemens, Fondazione CEUR, Fondazione Politecnico, ANIMP-OICE-FONDAZIONE LUIGI DE JANUARIO, PIRELLI & C., EUROCONTROL, C.T.G. Italcementi Group.

Typical career opportunities opened up by the doctoral program include the following ones:

- researchers and lecturers in Italian and foreign universities;
- officials of research and training bodies operating as a link between universities and private sector companies;
- researchers in economics and management working in the research departments of private corporations, financial institutions and public bodies;
- consultants in leading management and strategy consulting companies;
- managers and entrepreneurs of innovative companies.

The research projects that are presented in the following section are typical examples of the research work carried out by DRIG students.

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MANAGING SOCIAL INNOVATION: THE SHAPING OF INFORMATION AND COMMUNICATION TECHNOLOGY IN DYNAMIC ENVIRONMENTS

Sandro Battisti - Supervisor: **Prof. Fausto Giunchiglia**

The main original contribution of this doctoral dissertation is a model for the management of the social innovation in dynamic environments. This model is theoretically classified under the fields of open innovation, product innovation and service innovation, aimed at contributing towards the emerging field of social innovation. Furthermore, this model was built based on empirical evidences about social innovation enabled by information and communication technology, using multiple-case studies and clinical inquiry research. Moreover, the empirical study was based on the analysis of thirteen highly innovative projects in Brazil and Italy. These projects have been thoroughly analysed in the context of dynamic environments, which are special geographical locations that presented high variability in terms of the four main characteristics: *velocity*, the rate at which new opportunities emerge; *complexity*, the number of features of an opportunity that must be correctly executed to capture an opportunity; *ambiguity*, the lack of clarity such that it is difficult to interpret opportunities; and, *unpredictability*, the amount of turbulence in the flow of opportunities such that there is less consistent pattern. The main motivation behind

exploring this phenomenon is due to the fact that public-private partnerships have faced organisational challenges when they used the current innovation management models to develop social innovation to cope with social problems within dynamic environments. There are two main reasons for these challenges. First, the lack of consideration and attention paid to organisational ambidexterity that could support companies during the entire social innovation process. And second, is the local governments' predicament when faced with the ever increasing number of social problems, which becomes even worse during economic crisis. From the analysis of literature gaps in the context of dynamic environments, the research questions for the doctoral research emerges:

i. How can public-private partnerships develop social innovation, enabled by ICT and supported by relevant social groups, in order to cope with latent social needs of citizens whilst increasing the competitive advantage of companies in dynamic environments? ii. How can public-private partnerships organise the innovation process at the internal, open and social levels, in order to foster ambidexterity and support the development of social innovation in turbulent environments?

iii. How can public-private partnerships provide social and business value, in order to support small-medium enterprises to achieve services' early adoption and guarantee the temporary advantage in dynamic environments? The development of social innovation through public-private partnerships proved to be the most appropriate way to cope with social problems and with the exploration of new business opportunities. Furthermore, organisational ambidexterity supports companies in the management of social innovation within dynamic environments. Under conditions of environmental turbulence, the traditional models developed to deal with service innovation fail when applied to the achievement of social and economic goals. Environmental turbulence affects the social innovation process, because of rapid life-cycle changes in the availability of technology as well as the market needs. Moreover, this research assesses the traditional innovation management models presented in the literature, which have been well applied to cope with open service innovation. These models are focused more on the economic side of the innovation, addressing the reduction of risks for companies and the competitive advantage

within dynamic environments. However, these models seem unsuitable to cope with social innovation, more so with social innovation in dynamic environments. Thus, this research suggests that traditional service innovation models must be reinterpreted in order to cope with social problems as well as economic needs. From this perspective emerges the original contribution of this research, the model for managing social innovation. At the macro-level process of social innovation, the model is based on three different levels: internal, open and social. This model supports public-private partnerships for assessment of turbulence and ambidexterity during the innovation process. At the micro-level process, the model presents an in-depth framework in order to develop an understanding of the relationship between organisational innovation and user innovation. From this perspective, the overall contributions of this PhD thesis towards the innovation management field are divided into theoretical and practical parts, summarised as follows:

i. Theoretical contributions: The overall model for managing social innovation in dynamic environments is presented. It is based on innovations enabled by ICT, jointly constructed and shaped with user involvement in order to achieve social needs and cope with business opportunities. The model has been structured in three macro-levels of innovation process (i.e. internal, open and social). More specifically, the overarching model expands the research on innovation intermediaries by presenting a micro-level

process analysis. Furthermore, the research establishes two definitions for special types of innovation enabled by ICT. Thus, social innovation of high impact (SIHI) is a service solution for coping with social problems of the whole society in turbulent environments, and is also a process that is supported by organisational ambidexterity and developed at internal, open and social levels. And, social innovation in living labs (SILL) is an organisational form, which is managed by public-private partnership; it is aimed at fostering continuous interaction with citizens through the shaping of technology, in order to enable the citizens to use services that satisfy with their specific needs. Moreover, nine propositions for further research have been suggested in this research. These theoretical findings have been based on empirical data collected from more than five years of research, which serves as a solid ground, rooted in the integration of the five individual sub-models proposed in each of the five chapters of this thesis.

ii. Practical implications:

The research develops a social innovation impact matrix, which is useful to public-private partnerships in the selection of the kind of innovations that could be explored through the lens of the management of social innovations. In addition, the impact matrix suggests five drivers for building the social innovation process: assess the level of turbulence and ambidexterity; organise process in three levels (i.e. internal, open and social); build organisational ambidexterity on top of these three levels;

create specific channels to the civil society participation; support SMEs under conditions of high environmental turbulence. Moreover, from the empirical point of view, the model supports public-private partnership to better organise ambidextrous teams and to support SMEs in designing social innovations and finally the model enables the inclusion of civil society into the innovation process. Finally, the exploration of social innovation in living labs can impact society as a whole, once this kind of innovation intermediaries support companies in the co-creation of social innovation. Living labs can guarantee continuous engagement of social relevant groups with the innovation process and also after the launching of the innovation into the target markets. Thus, SILL can be a powerful organisational form that supports the fulfilment of economic and social needs of the stakeholders.

SET BASED CONCURRENT ENGINEERING (SBCE): A learning method to increase awareness level in industry & A methodology to identify and prioritize areas at a product level

Endris Kerga - Supervisor: Prof. Marco Taisch

The concept of set based thinking is originally proposed by researches from MIT (Massachusetts Institute of Technology) and UM (University of Michigan) in the 90's. Allen Ward pioneered the conception of this revolutionary idea during his Ph.D. research. Then, he and his colleagues were looking for industrial evidence that can exhibit the set based approach to product design and development process. They stumbled with Toyota's product development (PD), which in many ways resembles what they latter called SBCE (Set-Based Concurrent Engineering). Sobek, et al. (1999) summarized the definition of SBCE as engineers and product designers "reasoning, developing, and communicating about sets of solutions in parallel and relatively independent". Moreover, through observations of Toyota's PD, they devised three principles of SBCE, *principles of exploration, set based communication, and convergence*. Regardless of its origin, SBCE is much more sensible approach to PD than most industries are practicing, especially at early phases of design. Design and development is a unique process, where products and knowledge are created, discussed and realized. However, in the current industrial context, many companies are suffering due to poor PD performances. Lack of innovation, project delays,

cost overruns, poor qualities, knowledge wastes, and poor learning capabilities are among the challenges that industries are facing at the moment. SBCE, if integrated well, could significantly contribute to alleviate these challenges. It contributes to revolutionize companies to be true learning organizations. Through its principles, SBCE will guide designers and managers to orient themselves for the creation of high value products and strive to create usable knowledge in PD.

There is growing interests across industries to apply SBCE to improve their development performances. However, SBCE has not been well diffused as a PD practice in industries. The problems can be observed by looking at two gaps. The first one is related to the awareness level of SBCE by practitioners. In this thesis, I found that SBCE is not well understood and practiced by many designers and managers. Therefore, there is need for a method to introduce and to increase the awareness level of SBCE in industries. The second reason for the low diffusion is related to the extensive nature of SBCE to apply it for a product. To conduct a SBCE process for a product, designers should go through extensive phases (exploration of alternative sets, communication of alternative sets, test of

alternative sets and converge to optimal sets). Doing all these requires considerable time, investment and capabilities. In particular, for some industries (e.g. medium sized companies and SMEs) the challenges will be aggravated due to limited resources and capabilities available to conduct SBCE. The original principles of SBCE are derived from big automakers (especially Toyota) which are in different business context than several other industries. At the present, in literature there is a lack of systematic methods for introducing and guiding practitioners where in a product system to apply SBCE. The gaps should be addressed for helping companies (medium sized companies and SMEs) to benefit from SBCE principles. The main intent of this thesis is therefore to propose systematic methods to alleviate the aforementioned gaps existed in practice.

The first contribution of the thesis is related to the low awareness level by practitioners about SBCE. In this work, a learning method - called SBCE serious game - is designed and proposed to increase the awareness level of SBCE in industries. Gaming is very effective to introduce this novel model (SBCE) to practitioners. The game has been played by many designers and managers.

The game has been effective to increase their understanding level of SBCE principles.

The second contribution is related to the extensive nature of SBCE to apply it for a product. In this thesis a methodology called SBCE Innovation Roadmap (SBCE IR) is proposed. The purpose of this methodology is to guide designers to identify and prioritize areas (subsystems, components or design factors) that have to be the target for SBCE implementation. The SBCE IR methodology argues that designers should make rational choices to start SBCE implementation projects. Moreover, SBCE demands a rational and careful investigation a priori to identify where SBCE should be applied and use it to benefit customers with better product and increase value to the company. Otherwise, random efforts made on SBCE might be wasted without achieving the desired value. The SBCE IR methodology advocates that SBCE should be made in incremental manner rather than at full product level. The SBCE IR methodology is tested and validated in a real company (Carel Industries) on a real product, an Adiabatic Humidification System (AHS) designed by Carel Industries (www.carel.com).

In sum, in this thesis a SBCE serious game is developed to increase the awareness level of SBCE in industries. It is validated in a selected case company. Then, the SBCE IR methodology is proposed to guide designers to identify and prioritize areas to begin SBCE implementation at product level. This methodology is validated in the same case company. SBCE serious game and SBCE IR are the main contributions this thesis offers to industries and make methodological contributions to SBCE's body of knowledge.

RETHINKING FINANCE: RESPONSIBLE INVESTMENT IN THE EUROPEAN ASSET MANAGEMENT INDUSTRY

Daniela Laurel - Supervisor: Marco Giorgino

This dissertation explores the notion of **Rethinking Finance**, in the form of questioning previously established beliefs and models. In particular, it examines the current evolution of the European Asset Management industry as increasing institutional pressures push organizations to change their business models and integrate sustainability into their traditional investment practices. This is manifested in the phenomenon of Responsible Investment (RI) – any type of consideration of Environmental, Social, Governance and Controversial Business Involvement issues within the investment process.

The objective of this dissertation is two-fold: first, to examine the mechanisms underlying institutional change within the context of field-level institutional complexity and within a situation of *transition*, wherein organizations are embedded in a dominant logic while subject to pressures from a new, conflicting logic that does not bring with it theorized definitions or models of success and second, to provide an illustration of whether and how this rethinking is manifested within financial markets.

This dissertation is composed of three standalone papers.

Chapter 2. Institutional Complexity in a Transition Field: Responsible Investment in the European Asset Management Industry asks the question, *how do organizations experience and respond to institutional complexity in a transition field?* Employing a qualitative, abductive, exploratory approach, my co-authors and I perused interviews (25 in total) with significant decision makers in the European asset management industry as our main source of data. We then triangulated this with archival data and participant observation in order to provide a contextual analysis of change.

We find that in a situation of transition, organizations make sense of institutional complexity through *logic assimilation*, which has two core mechanisms, *logic theorization* and *logic-archetype elaboration*. *Logic theorization* is the usage of an incumbent logic to frame and translate the untheorized logic in order to make it compatible with the incumbent logic. Unlike previous accounts that highlight that theorization must be successful prior to diffusion, we posit that theorization and diffusion occur simultaneously. Through logic theorization, asset managers were able to form new theoretical

conceptions of sustainability that was acceptable to themselves as players embedded in the financial logic. They did this by ‘translating’ the sustainability language into a financial language more understandable to asset managers, simultaneously using models and tools to assist them in theorizing. *Logic-archetype elaboration*, on the other hand, is the redefinition of the incumbent logic and consequently, its archetypes, based on the characteristics of the incoming untheorized logic. Asset managers began to rethink the financial logic by examining the drivers of performance and risk given the characteristics of the sustainability logic. Asset managers began to create and subscribe to the belief that examining non-financial issues would provide informational benefits that would enable them to make better predictions for the future. They also began to believe that that it was imperative to engage in the practice because of the strong demand from and the ‘stickiness’ of RI clients. We find that these two mechanisms are recursive and underlie institutionalization. This chapter also highlights the existence of an enabling organization, in this case, the Principles for Responsible Investment (PRI), as a facilitator of logic

assimilation, which provided definitions, coordinated action, and legitimacy in this process. The PRI created ways for asset managers to take financial models and concepts and use these to frame sustainability, providing the latter with the possibility to be defined by the same language.

Chapters 3 and 4 address the second research objective using a self-constructed dataset of European Socially Responsible Investment (SRI) mutual funds. Apart from their usual investment strategy, these funds use screening mechanisms, or the selection of investee firms based on pre-defined ESG and CBI criteria. The dataset uses a primary list of 529 SRI Mutual Funds domiciled in Europe as identified by the European Social Investment Forum (Eurosif). After adjustments from data availability and outliers, I reach a final unbalanced panel of 187 equity mutual funds for Chapter 3 and 88 equity mutual funds for Chapter 4. Historical financial data is provided by Morningstar and from public data sources, taking the time period April 2003 to March 2012. The dataset is the most complete European dataset to the best of my knowledge.

In **Chapter 3. Responsible Investments: the Assimilation of Sustainability-related Sources of Risk**, I illustrate how logic assimilation is manifested within financial markets by theorizing and providing evidence that (1) sustainability information and (2) moral preferences of clients have a significant relationship with financial risk and fund

flow volatility, respectively, in substantive (highly committed) forms of RI. This chapter moves away from the SRI versus non-SRI performance debate and provides empirical evidence that the process of logic assimilation is manifested within financial capital markets, particularly in terms of the drivers of financial risk. Particularly: informational benefits lead to a decrease in idiosyncratic risk at a substantive level of RI and ‘stickiness’ from ethical considerations and normative legitimacy lead to lower levels of fund volatility at substantive levels of RI. The chapter highlights that traditional models of finance remain dominant yet new ideas related to sustainability are gradually penetrating and manifesting their presence and implies in practice that engaging in RI remains attractive because of its unique risk profile, mainly supporting a case for a deep level of commitment.

Finally, in **Chapter 4. Rethinking Finance: Sustainability Governance in Responsible Investment**, we focus on sustainability governance practices (sustainability disclosure, sustainability activism, and sustainability research). We illustrate how logic assimilation is manifested within financial markets by asking the question, *do sustainability governance practices have an effect on financial performance and fund attractiveness?* We find that disclosing SRI criteria is positively related to financial performance, illustrating that sustainability disclosure signals positive sustainability performance and such sustainability performance

is rewarded by capital markets. Further, we find that SRI clients are more likely to support a fund that displays a strong amount of commitment to sustainability, especially in terms of internalizing sustainability research. Finally, we find that despite a negative underlying performance impact of having high governance intensity, investors with an ethical concern remain willing to support a well-governed fund. We show in a first attempt that governance practices related to sustainability issues – often overlooked in the literatures – are value-relevant, highlighting the need to include such issues as part of the overall strategy of a fund.

This dissertation incorporates the notions of conflicting logics, institutional embeddedness, and logic assimilation within previous work in the Social Studies of Finance, harmonizing complementary views from Institutional theory. It further goes beyond previous ethnographic and descriptive work and illustrates how such a reconceptualization of previously well-established beliefs *perform* markets and become manifested in financial models, thus providing an important empirical linkage between the experience of institutional complexity and actual practice change in financial markets.

ENHANCING THE DECISION MAKING PROCESS LEADING TO THE IMPLEMENTATION OF OCCUPATIONAL SAFETY AND HEALTH INTERVENTIONS IN SMALL AND MEDIUM SIZED ENTERPRISES

Donato Masi - Supervisor: Prof. Paolo Trucco

The research project started with a description the decision-making process leading to the implementation of Occupational Safety and Health (OSH) interventions. In order to implement OSH interventions in the workplace, OSH practitioners have to manage three main steps of a complex decision-making process. First, OSH practitioners should decide whether to invest or not in safety interventions, or they should convince the management and other stakeholders to devote resources for the improvement of the OSH conditions of the enterprise. Second, OSH practitioners have to set the intervention policy. Third, OSH practitioners have to design the specific intervention. The state of the art related to the three steps of the decision-making process leading to the implementation of OSH interventions showed three main gaps. In order to trigger OSH interventions, OSH practitioners can rely on the regulation strategy or on the knowledge strategy. However, neither the regulation strategy nor the knowledge strategy seem to be enough to trigger OSH interventions and a third strategy could consist in critically combining the regulation strategy and the knowledge strategy. However, it is necessary to understand in which way the two strategies should be combined and it is necessary to clarify the possibility of demonstrating

the economic benefit of OSH interventions, which is a key argument of the knowledge strategy. As for setting the intervention policy, existing models do not allow for a comprehensive assessment of the safety performance of the company, thus limiting the possibility of setting an effective intervention policy. As for designing OSH interventions, it is necessary to modify the way of designing OSH interventions, taking into account the mechanisms and the contextual factors affecting the implementation of interventions. The main research question can be stated as follows:

How is it possible to enhance OSH interventions in SMEs?

In the light of the gaps in the decision-making process, the main research question generated 6 sub-questions. Each chapter of the thesis answers to a specific sub-question. The 6 sub-questions and the conclusions are presented in the following.

Research Question 1: How is it possible to demonstrate the economic benefit of OSH interventions in SMEs?

The research performed in the first part of paper 1 provides an overview of the techniques which can be used in order to demonstrate the economic benefit of OSH interventions in SMEs. The relevant features of currently

available evaluation approaches are described and the main difficulties are highlighted and discussed; emphasis is put on the needs and particular constraints of SMEs. Thanks to this overview, OSH practitioners that want to understand the economic benefit of OSH interventions or OSH practitioners that want to demonstrate the economic benefit of OSH interventions to the management can critically select the most appropriate technique. Summing up, the study structures and critically evaluates the existing knowledge, thus making this knowledge easily usable by OSH practitioners.

Research Question 2: How is it possible to combine the regulation strategy and the knowledge strategy in the triggering of OSH interventions in SMEs?

The research performed in the second part of paper 1 suggests to shift from the traditional order of policymaking, in which the legal compliance is the first matter of concern (regulation strategy), towards more focus on the economic value of OSH (knowledge strategy). OSH practitioners should shift from putting emphasis on the need of being compliant with the regulation to putting emphasis on the economic value of OSH. If the monetary value, by itself, is positive, then policy-makers will have no trouble to go forward

and any additional qualitative like benefit will bring an welcomed extra motivation. In contrast, there are two ways that might help: (1) to take into account all possible qualitative benefits; even if uncertain and subjective, they can help to "make the case". A list of qualitative benefits, which are not considered by the existing techniques, is provided in paper 1; (2) to have a third party (typically a governmental agency) giving encouragement through an incentive (e.g., subsidy or tax reduction), based on clear rules and observable final results.

Research Question 3: How is it possible to comprehensively describe the safety performance of a SME ?

The research performed in the paper 2 proposes a model of safety performance for SMEs which is systemic, intervention-oriented, and SME-specific. Being systemic, the model allows for a comprehensive description of the safety performance of a SME. OSH practitioners, while setting the intervention policy of the company, can use the model in order to have a comprehensive view of the safety performance of the enterprise. This comprehensive view should support the identification of the correct intervention priorities.

Research Question 4: Which are the features of the actual OSH intervention process ?

In order to answer this question, this exploratory study gives an overview of the key features of the actual intervention process in SMEs and of the contextual factors making this actual intervention process similar or dissimilar to the ideal case. The results show how much qualitative and experience-

driven the actual intervention process is. Thanks to these results, practitioners can be aware of a benchmark for the OSH intervention process, and, at the same time, they can increase their awareness of some limitations of an "average" actual intervention process. In such a way, they could direct future efforts in order to develop, implement and evaluate their OSH interventions in an "ideal" way.

Research Question 5.1: Which are the relevant contextual factors hindering the intervention process?

The study carried out exploratory research in order to produce a first picture of barriers to OSH interventions in SMEs. The study structures the existing knowledge on barriers, thus making this knowledge easily usable by OSH practitioners. At the same time, a preliminary overview of the most perceived barriers creates some warnings for OSH practitioners, highlighting the factors to which a particular attention should be devoted.

Research Question 5.2: Which are the relevant contextual factors fostering the intervention process?

This study carried out exploratory research in order to produce a first picture of drivers for OSH Interventions in SMEs. The study structures the existing knowledge on drivers, thus making this knowledge easily usable by OSH practitioners. At the same time, a preliminary overview of the most perceived drivers creates some warnings for OSH practitioners, highlighting the factors that in a relevant number of companies had a relevant role in the improvement of the OSH interventions process.

Research Question 6: How is it possible to use the knowledge on the intervention process and on the context for the enhancement of OSH interventions?

The knowledge on the intervention process and on the context can be used for the enhancement of OSH interventions thanks to the model proposed in chapter 6 and tested in chapter 7. This models supports the design of OSH interventions guiding practitioners step by step in the identification of the mechanisms determining the performance of the workers and of the contextual factors enabling or disabling these mechanism. The test shows that the model does support practitioners during the design of the intervention, highlighting specific aspects of contextual factors and mechanisms, and organizing the data in a more organic and structured fashion.

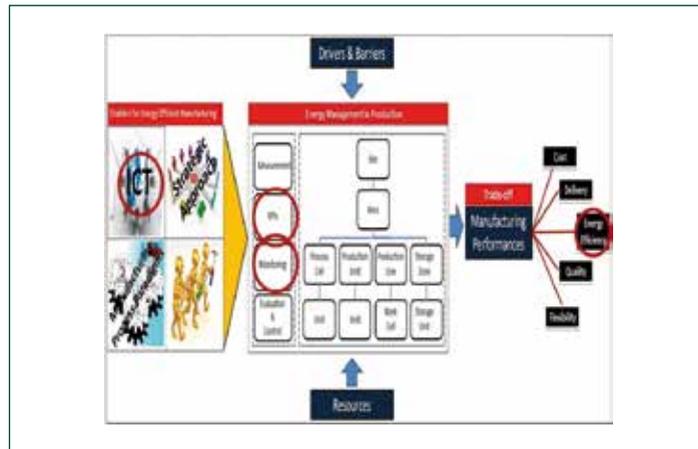
KPI INTELLIGENCE FOR ENERGY MANAGEMENT IN MANUFACTURING

Gokan May - Supervisor: Prof. Marco Taisch

Nowadays, companies have to consider efficient use of energy and resources in manufacturing besides traditional performances to become and remain competitive in their respective industry. Thus, manufacturing firms must put more efforts on in-depth analysis of energy and resource performance within their manufacturing processes and facilities. A comprehensive process design and plant optimization with a specific focus on energy efficiency is of paramount importance for this purpose. Currently, such appropriate concepts and tools for dealing with energy efficiency as a performance criterion are too few in the manufacturing industry and the existing ones mainly lack holistic consideration of the overall plant. Potentials to improve energy efficiency are far from being exploited as mentioned by many scholars.

The framework of the research, that considers different aspects and their relationships in the specific research area, and highlighting the main focus of the study, is shown in Figure 1.

This theoretical framework is inspired by the structure of a typical IDEF0 diagram. However, the research framework is designed in a conceptual level rather than a physical one, with the purpose to describe



1. Research Framework

the activities and key factors required to integrate energy efficiency in manufacturing from the viewpoint of plant manager and/or energy manager of a manufacturing facility. This study is based on the main problem that there is a lack of holistic methodology and decision support for handling the energy efficiency issue in manufacturing. Hence, this research intends to establish a basis for the companies and academia to have an understanding on how to successfully integrate energy efficiency in manufacturing and to understand the role of ICT as an enabler for energy efficient manufacturing, investigating how ICT can be facilitated accordingly. facility (i.e. site, area, tool, etc.). Thus, this first

phase aims at developing a structured methodology for measurement, analysis and improvement of energy-related performances of manufacturing firms through the design and use of a novel Energy KPI system, with the purpose of supporting them in energy related decision making. The cross view methodology generates Energy KPIs according to cause-effects relationships between manufacturing system and energy consumption, and allows to effectively exploit potential brought by energy measurement and monitoring technology to provide energy managers the detailed information to properly address continuous improvement of energy performances. The second part supports the

first part by developing an approach to improve energy efficiency in manufacturing by facilitating monitoring and control through ICT-supported KPI intelligence serving as a decision support tool to enhance energy management in manufacturing plants. The aim is to foster consistent and continuous calculation of KPIs for which the variables come from disparate data sources and hence increase the visibility and transparency of the identified KPIs.

This study therefore targets an innovative generic solution for integration, processing and visualization of energy-related data since the integration of data and information coming from multi-vendor production IT systems (i.e. ERP, MES, SCADA, special-purpose solutions, etc.) to enable consistent calculation and visualization of desired indicators is of utmost importance in current enterprises. Highly integrated shop floor-based platforms and systems in cooperation with the enterprise software are essential for this kind of application. The approach taken to the development of this tool is prototype based, use case driven, using iterative cycles of requirements gathering, design and development. This business driven development approach provides a progressively mature

understanding of the identified business needs of all the industrial use cases through requirements elicitation and use case verification. These requirements are validated by the prototypes closing the verification circle. Between these two activities lies the architecture definition acting as a bridge ensuring that the iterative nature of the requirements gathering aspects can be maintained whilst allowing the development aspects to work from fixed stable base points.

The main approach thus concerns definition of the use cases, identification and analysis of requirements for an ICT-based decision support system based on the integration of production IT systems in manufacturing environments for enhanced energy management, elaboration of the core architecture of the main system using these requirements and the implementation of proof of concept prototypes along with the synergies and feedback loops between these steps. This enhanced energy management approach has been designed in a collaborative project setting, conducting several interviews with the technical responsible of manufacturing firms and carrying out technical environment analysis of manufacturing facilities from different sectors and was

validated through industrial prototypes. The principal beneficiaries of this study are energy managers and plant managers of manufacturing companies, who have the goal of improving energy efficiency in their manufacturing system through strategic approach. Since the dissertation will also highlight the gap between academia and industry serving as a reality check between what is being developed in theory and what is implemented in the real business context and thus help to identify future research directions in the area, academics in energy related research fields will benefit from the findings as well.

Keywords: Energy Management, KPI Intelligence, Energy Efficiency, Manufacturing, Key Performance Indicators, Information and Communication Technology, Decision Support System

THREE ESSAYS IN ENTREPRENEURIAL FINANCE: The role of business model, intellectual property right and inter-organizational ties

Ali Mohammadi - Supervisor: **Prof. Chiara Franzoni**

This thesis contributes to literature on financing entrepreneurial ventures by looking at different attributes of entrepreneurial ventures. It particularly studies the role of Business Model, Patents and Discontinued investment by previous investors. The thesis is structured in three separate chapters.

The first chapter investigates the impact of adopting Open Business Model by entrepreneurial ventures on the quality of VC financing and governance of the investment. We do so by comparing proprietary and open source software entrepreneurial ventures. The quality and governance are expected to differ since entrepreneurial ventures, which adopt open business model, are associated with higher complexity and risk. Empirical analysis are based on 514 software entrepreneurial ventures in the North America that received VC funding in 6,555 different deals extracted from VentureXpert. The results show entrepreneurial ventures with open business model receive funding from VCs that are more connected in the network of investors and have higher quality. Also, entrepreneurs that adopt Open Business Model are monitored more intensively through more frequent staged investment

rounds.

The second chapter drawing on the literature of information asymmetry and signaling looks at patents as reputation signals in Initial Public Offering (IPO) and investigate the fate of those patents once they have been granted. The chapter builds on works that looks at patents as reputation signals and expand the literature by analyzing the fate of those patents once they have been granted. By acting as a signal, patents can inform observers about attributes of not just the patent, but the patentee itself, and if patents are correlated with less readily observable firm characteristics, patents can serve as a signal of firm quality, more specifically, how innovative a firm is. Using a multi-industry sample of 30,891 US patents from 385 assignees, we find a significant and positive relationship between the likelihood of patents expiring due to lack of maintenance fee payments and the time to IPO. We also find that patents associated with entrepreneurial ventures which are not venture capital backed, are more likely to expire. The third chapter investigates how early termination of VC investment in entrepreneurial ventures affects the ability of these young ventures into acquiring further resources necessary for survival and

growth. We propose that young entrepreneurial ventures face a higher cost of external financing if existing investors stop investing in the next rounds of financing. The continuation of investment by existing investors confers a positive signal about the quality of young ventures. Hence young ventures, as endorsed by further commitment of capital, are more likely to perform better than otherwise comparable ventures that lack escalated commitment. The chapter contributes to the literature that investigates the role of inter-organizational ties as information about the quality of entrepreneurial venture. Using 5,016 rounds of VC investments in 1,728 entrepreneurial ventures that received more than one round of investment we find that early VC termination in a new venture is a negative signal of the quality of the venture and lead to reduction in the size of investment and the quality of future investors in the next round of investment.

SYSTEM OF SYSTEMS FOR INDUSTRIAL AUTOMATION: towards Energy Efficient Systems

Dorian Oswaldo Mora Sanchez - Supervisor: **Marco Taisch, Armando W. Colombo**

Nowadays, energy is one of the most misused resources on Earth. This phenomenon is caused because of the continuing technological expansion in different areas such as building automation, oil & power, industry in general, and much more areas where energy consumption is extremely high. As the future generations are very important, the main aim is to prepare proposals, based on new models, in order to reduce the energy consumption and generate energy efficient systems.

Industrial automation is an area where energy efficiency can be reached by innovating automation and control systems, designing and implementing architectural innovative models to the actual systems available today. This also implies the existence of an adequate communication and integration of system components to allow the collection of energy related information starting from the single devices like sensors and actuator, operator rooms, control stations, and even remote supervision systems located far from the shop floor. This data allows that emerging functionalities and capabilities which appear from the interaction of the individual systems will react to succeed any specific goal. In order to reach such integration, a System

of Systems (SoS) approach can be the architectural solution where the individual systems will keep their management independence, operational independence, individual properties and functionalities, heterogeneity, but at the same time, their interaction will generate new emergent functionalities, properties, and capabilities facilitating evolvable structures and behaviors, which are not present in the individual systems, it would also depend on the dimension and extension of the SoS.

The System of Systems has an initial set of characteristics and properties, which match with the complexity and set of requirements exposed by Energy Management Systems. Regarding to the industrial automation, a System of Systems configuration could be reached by fitting the integrated subsystems with the concept of System of Systems. A correct energy management of the System of Systems will be a key point in order to achieve the main goal of having energy efficient System of Systems. The high levels of energy consumed in industrial automated systems such as conveying, packaging, hoisting systems, automated machine solutions, and system of systems, require an optimal regulation of energy

consumption. Technology has a key role in order to achieve this goal, for this reason, global market leaders in the electrical context are developing new models and tools towards a sustainable energy management.

The multinational company Schneider Electric (=S=) belongs to that group of global market leaders which has already generated a new strategy based on a four-step method to generate benefits in two ways: energy cost savings to the customer and energy efficiency to the environment, and the implementation of new libraries added to an automation programming software platform makes energy monitoring process an easier job. This dissertation describes a body of research which has been done on applying the concept of Energy Management and System of Systems to the Industrial Automation context. In this work, a literature review and summary of European research projects of the different technological components of today's Industrial Automation and Energy Management have been presented.

Based on all the collected information, some case studies have been executed such as: to a European project towards large System of Systems, to managerial decision-making

process at Schneider Electric towards Sustainability, and to the actual Energy Management strategies used by Schneider Electric; as a result of these studies, a new Industrial Automated Energy Efficient System of Systems (iaEESoS) model has been suggested towards energy efficient System of Systems. Also, in order to validate the described new model, a collaborative research has been executed while implementing the new suggested iaEESoS to Schneider Electric and adapting a new Six-phase Energy Efficiency Integrated (6EEI) model for =S=, and this model implemented into a real life water pumping system. To finalize, conclusions and a perspective for future researches have been proposed. Finally, as a summary it can be established that the main purpose of this research is to present an Energy Management approach based on a topic that today has a lot of importance worldwide. As energy consumption in Super Systems could increase, the objective is to generate an Energy Efficient System of Systems.

Problem Description

The world is facing some of the biggest challenges in history such as global warming, disappearance of water resources, care of energy consumption, technology and information growth. For this reason, researches around the world are trying to investigate in how to provide possible solutions for the future in order to counteract against these social problems, which involves every human being looking to protect the energy resources for

future generations. Energy resources are in the focus of the international community, with the strategy to create conscious worldwide. Most of the resources used to generate energy are non-renewable ones, for this reason actions are been taken such as the use of renewal energy, energy consumption plans, rate structures for energy consumption and demand, etc. The energy consumption varies according to the place where those "giant" consumers are located, but in general most of them are located not only in the mature economies including the United States of America, European countries, China, Russia, but also in the emerging economies like India, Brazil, Australia, etc.

In those countries, due to the continuing growth of industry areas such as home automation, power & oil, mining, manufacturing in general, process automation, etc. but also the buildings, infrastructures, and more factors, the consumption of huge amount of energy has been increased. This means, that energy consumption has been increased in those areas based on "systems" for building such as heating, ventilation, air conditioning, power distribution, monitoring, elevators, building automation, security; and systems for industry such as automation, power supply, electrical distribution, conveying, packaging, hoisting, pumping, textile, assembly lines, logistics, etc.

As those systems become bigger and bigger, as a result are the called "Large Systems", where

the energy consumption is also increased, by increasing the demand and energy peaks, therefore generating a huge damage for the environment because of the increase of gas emissions.

From those super systems or system of systems, today there is a lot of information about energy efficiency, demand management, systems of systems, and companies are trying to take the best decisions in order to get and provide more benefit for them and for the people respectively. But in reality, it is not enough and new models are needed.

Those companies, especially from the Industry business, need to care about energy efficiency, which could be reached by designing and implementing architectural innovative models to the systems available today. An adequate communication and integration of system components would allow the collection of real-time data starting from the lowest level like sensors and actuator, operator rooms, control stations, to highest level such as management systems. It is possible, but the main fact that companies have to use is the new technological advances in order to reduce drastically energy usage in the industrial world.

The main idea is to present a possibility to get energy efficient system of systems, specially for companies, such as Schneider Electric, that promote themselves to pursuit Energy Efficiency in their portfolio, and the aim is to get valuable information about the new approaches in order to generate energy efficient Systems.

SELF-ENGAGEMENT IN INNOVATION ACTIVITIES: WHY SHOULD I PARTICIPATE? Analysis on antecedent of the user's activation in self-engagement innovation activities

Elena Pellizzoni - Supervisor: Prof. T. Buganza, Prof. A. Griffin

Increased competition and the reduced lifecycle of products, services and technologies are forcing companies to face innovation problems more frequently than in the recent past. In order to increase the effectiveness and the efficiency of their innovation processes, companies are developing new and faster ways to access different and diverse knowledge domains. New types of innovation activities have been designed and developed in order to achieve this objective. Researchers have classified them according to specific characteristics such as source of the innovations (Open v/s Closed), degree of collaboration and degree of novelty (Incremental v/s Radical), and so on. In all of these cases the reason why these actors collaborate in the innovation activities may be twofold. In some cases, participating in innovation processes may be part of their running business activities (e.g. an engineering company providing technical design help or a customer providing technical support to facilitate the integration of a new component). In other cases, participation is completely voluntary and involves participating in activities far from one's business or current efforts. In an open innovation platform like Innocentive, participation is

spontaneous: solvers around the world decide to subscribe and actively participate. It is not their normal job, they decide to do it for other reasons. It may be interesting to understand the motivations that impact the choice to participate. Is it only for the award? It's difficult to believe that the award is the only reason: the probability of winning is limited. Only one out of the 5,169 solvers received the reward in the case of Netflix. The effort to prepare the solution and to submit it for most solvers will be higher than the expected reward (i.e. the benefit obtained in case of winning multiplied by the probability of winning). The effective profit value may be negative. It seems that the balance between cost (e.g. effort to prepare a solution or give an idea) and expected benefit (actual award*winning probability) will not explain completely the choice to participate. There likely are some other explanations. People do not always choose to act for expected profit but are motivated in some other ways that could be indirect (e.g. visibility) or hidden (e.g. enjoyment). The objective of this thesis is to identify the motivations that push people to activate themselves in self-engagement innovation activities.

Furthermore, this research aims to identify the impact of motivation not only on self-engagement but also on the quality of the activities voluntarily performed. Understanding which mechanisms increase both the quantity and the quality of self-engagement is a first crucial step to be able to design more effective collaborative innovation processes. Starting from the analysis of these initiatives, a main issue emerges. Considering, for example, the case of the Innocentive challenge, it would be easy to study the motivations of solvers who participated, but it would be almost impossible to find and study those who knew about the challenge and decided not to participate. Given the objective to understand the whole phenomenon that leads some people to participate while others to not, it is necessary to consider "confined" communities. A confined community is defined as a community that exists beyond the innovation initiative, clearly identifiable and with defined boundaries. A confined community will make it possible to find the non-participants and to study their (lack of) motivation. By comparing the motivations of the two subsamples (participant, non-participant) the identification of

discriminating motivations that explain the different behaviors can be investigated.

The research seeks to find similarities across many different domains to increase its abstraction level and its generalizability. Considering the confined community constraint, the two selected self-engagement innovation initiatives are university contest (UC) and idea management system (IMS). University contests are a particular type of innovation contest in which the community of solvers is narrowed to the university students of a specific and defined university. In this contest a company launches a challenge on an innovation problem and the students are asked to give solutions. Participation is completely self-engagement. Idea Management Systems are processes inside a company built to obtain general or problem-specific innovation ideas from employees. The process is not mandatory for the employees' community, but it is rewarded with monetary awards and other prizes. The two areas allow the investigation of the same phenomenon of self-engagement in innovation activities with changes some contest variables. The framework, derived from motivational theories and enriched with additional variables that emerged during the studies, is applied to explain the intensity of participation in the two self-engagement innovation activities, characterized by different communities, processes and organizations. Behavior, the dependent variable of the study,

is not only the activation of the solver, but also the intensity of the participation that is explained by the quality of the submitted solutions. Intensity of participation, activation and quality of the submissions are grouped into a single variable. Using the same research framework in the two areas, it is possible to analyze if the variables are cross content or content-specific. The different design variables across the two areas may, indeed, lead to different results or, on the contrary, may find that the same mechanisms explain the intensity of participation in self-engagement innovation activities. To enrich the analysis and make it more robust, more than one study is performed in each area. The framework is investigated in two empirical fields. Two different countries in each area of investigation are selected. Politecnico di Milano and University of Utah are the empirical fields of UC studies. The IMS is analyzed two operating companies of a multinational firm, the Portuguese and the Italian ones. This choice makes more generalizable the results in each area. In addition, in both areas an extension is done. From the literature reviews, additional gaps are found. To investigate the specific phenomenon, a study in each part is added. Research and managerial implications are drawn in each investigation area and some conclusive considerations are presented. The general structure of the framework seems have a similar impact on the two self-engagement innovation activities. Moving from these

analyses to a deeper level, for example the single type of motivation or the specific opportunity, it seems that the sample, context and culture influence the results. Multiple layers have to be considered in the investigation of the reaction to self-engagement innovation. Layers shape the reaction on self-engagement innovation activities. At the macro-level perspective, the general framework of the enriched model may be applied in all the self-engagement innovation activities. Then, the sample impacts on the mechanisms of participation. Activating a student is different than activating an employee. Another layer is then the organizational initiative. Finally, the country in which the analysis is performed impacts also on the variables in the framework. The values and the culture of the nation, indeed, impact the mechanism of reactions. An important additional research implication is let by the analysis. The importance of single respondent methodologies in the literature is growing. Different researchers in the extant literature have analyzed students' samples, given the convenience. Experiments and surveys are often performed on students' samples and then generalized to all possible populations. This analysis has underlined that this type of research may make mistakes in the generalizations.

UNDERSTANDING THE ROLE AND CONTRIBUTION OF INTER-ORGANISATIONAL INFORMATION SHARING AND COLLABORATION TO CRITICAL INFRASTRUCTURE RESILIENCE: A MULTIDIMENSIONAL INVESTIGATION

Boris Petrenj - Supervisor: Prof. Paolo Trucco

The resilience of Critical Infrastructure (CI) systems has become one of the key elements to assure not only the continuity of operations but the availability of vital functions for modern societies. Considering CI importance, frequent disruptions (caused by natural disasters, terrorist attacks, traffic accidents, system errors, etc.) have forced societies to respond to crisis situations as effectively as possible.

CIs have gradually evolved into the patchwork of physical networks, old and new technologies, actor networks and institutions, making a very integrated system of systems. Connections and services between CIs, as well as extreme development of ICT control, made CIs highly interdependent and prone to cascading disruptions. Furthermore, CIs have undergone massive institutional restructuring – privatisation, deregulation and liberalisation. While becoming highly *technically interconnected* their management has become increasingly *institutionally fragmented*. Infrastructure systems include both a physical and a social (actor) network and their interaction. Since no single organisation has all the necessary resources, possesses all the relevant information or owns expertise in handling all types of extreme events, *information*

sharing and collaboration among diverse actors have been recognised (by researchers, infrastructure operators and governmental agencies) as a critical part to protect CIs and ensure their resilience. Still, the achievement of collaborative interactions among actors that are highly heterogeneous in organisational structure, crisis management procedures and technological assets, represents a great challenge during the crisis. The diversity among the stakeholders/organisations also leads to numerous organisational and policy issues (e.g. different responsibilities, competing priorities) which hinder communication and collaborative efforts between public and/or private managers. The characteristics of both governance model (e.g. type of Public-Private Partnerships) and operational model are relevant to increase the resilience of CI systems. Current CI Protection and Resilience (CIP/R) approaches proved to be inadequate and with major limitations. Significant problems are arising from the lack of collaboration throughout the phases of Emergency Management.

The theoretical and practical aims of this research are:

- To theoretically study and empirically confirm barriers and issues to information

sharing in context of CIP/R, evaluate ability of emerging concepts to overcome the issues, and contribution of improved collaboration models to CI crisis management and resilience.

- To enhance efficiency and effectiveness of CI crisis management in means by improving information sharing and operational collaboration, increasing the level of inter-organisational resilience capabilities and interoperability in a network of regional CI crisis response actors.

This work is at the cross-border between technology and management where facts, both deterministic and uncertain, combine with values, beliefs and behaviours. It is not just dealing with technology and robust information sharing, but it is also about human and organisational behaviour. In this light of socio-technical system (STS) perspective, collaborative processes may benefit CI resilience by acting on both system dimensions – *Technological (interdependency analysis) and Organisational (Service Oriented Architecture (SOA) & Network Enabled Operations (NEO) concepts)*. Taking STS position, we have decided that it is appropriate to use *mixed methods and approaches*, where either approach (used

at different stages) could yield valuable data and best meet researchers' needs and purposes. Accordingly, we have integrated qualitative and quantitative data collection techniques and analysis procedures to strengthen the validity and quality of data analysis and research findings.

The first result came from the *literature review* from which we were able to identify the complete spectrum of barriers and issues to information sharing and collaboration among actors in CI crisis response. The study showed tight connections among the barriers and highlighted the importance of matching organisational structure characteristics, technological capabilities and sociological influence for improving CIP/R. Advocates of SOA and NEO concepts, documented experiments and empirical evidence from the case studies confirm that many of the identified *successful practices* for information sharing are based on the SOA and NEO principles and pre event experience of working together.

In practice, the challenge of CIP/R is faced through formation of Public-Private Partnerships (PPPs), which emerged as a response to the current and upcoming trends affecting infrastructures. In general, PPPs aim to remove existing barriers to collaboration and information sharing while building missing bridges between the actors/organisations and trying to establish needed relationships and interactions. We have empirically analysed, through *exploratory-explanatory multiple case study*, some of the widely recognised PPP best practices:

- Centre Risque and Performance (CRP) in Montreal, Canada;
 - LA BEOC in Louisiana, USA;
 - PNWER – Center for Regional Disaster Resilience in Seattle, USA;
 - Lombardy Region in Italy.
- Each of the PPPs managed to channel information flows, increase intensity of shared information, make the information actionable upon, and improve the aspect of CIP/R they have aimed for, still applying NEO/SOA principles in very limited form. We were able to note contribution of PPPs to CIP/R, to identify factors influencing and shaping PPPs, to see how different challenges were faced and solved in an innovative way and, probably the most important – we apprehended the two value chains corresponding to the gaps we have investigated:
- The first, where pre-event joint activities and information sharing combined with application of SOA/NEO concepts lead to improved information sharing and collaboration during the response (during-event) phase of EM;
 - The second, starting from information sharing and collaboration, subsequently enabling actions and activities based on it, and at the end resulting in a set of CIP/R benefits.

Even though PPPs are still not able to reach high levels of collaboration and resources sharing they present more advantageous option than applying the traditional approach. The findings affirmed again that PPP presents a comprehensive approach when dealing with CIP/R. We

argue that PPPs present an adequate way to tackle CIP/R issues on regional/local level if implemented adequately. Thanks to enhanced information sharing processes among the organisations involved in the incident response it is possible to have improved resilience practices such as preparedness or responsiveness consisting of enhanced anticipation and better situational awareness. Benefits of the reduction in response times were estimated through *simulations* based on a real snowfall scenario disrupting the transportation system in the metropolitan area of Milan. Simulations have shown that efforts best materialise in benefits locally, which indicates the need for joint local actions, based on situational awareness built upon efficient information sharing. Information needs to be shared in specific areas, based on pre-event interdependencies identification and analysis – in this manner the highest benefits can be reached. This approach has been successfully used in practice within PPPs. The dissertation investigated the role and contribution of inter-organisational information sharing and collaboration to improvement of CIP/R. It explained and justified why information sharing deemed and proved to be one of the crucial aspects of modern age CI resilience. It has both expanded academic knowledge in the field and brought benefits to stakeholders/practitioners. Finally, limitations and directions for future research have been outlined.

EMBEDDING ENVIRONMENTAL SUSTAINABILITY IN HEALTHCARE ORGANISATIONS: THE ROLE OF HUMAN RESOURCES

Marta Pinzone - Supervisor: **Ing. Emanuele Lettieri**

The dissertation, by means of the three papers of which it is composed, primarily aims at contributing to the on-going debate on environmental sustainability issues in the healthcare sector and, specifically, on the importance of employees engagement in pro-environmental behaviours and on how promoting employees' attitudes and behaviours necessary to sustain the adoption of pro-active environmental practices, the achievement of a more effective environmental management and a better environment-related performance.

The literature on environmental sustainability has in fact mainly focused on manufacturing firms and "dirty industries" and has overlooked the impact that service organisations have on environmental issues. Furthermore, investigating predominantly the topic in non-professional organisations, past research has offered a few insights on the peculiar barriers managers of professional organisations may encounter during the introduction of sustainability-oriented activities in their organisations and has provided them with a few ready-to-use recommendations on how to overcome these barriers.

The first paper of the dissertation asks two research questions: *i) Which drivers*

affect the adoption of Proactive Environmental Strategies in healthcare organisations?

ii) Which barriers impede the adoption of Proactive Environmental Strategies in healthcare organisations?. The study focuses on the interplay between stakeholders' pressure for environmental protection and the presence of barriers within the organisation (i.e., lack of resources, difficulties in evaluating impacts and lack of commitment) in driving the adoption of pro-active approaches to environmental issues among healthcare organisations. Integrating these two bodies of knowledge, which have evolved in parallel during the years, the paper develops and empirically tests a parsimonious framework that interconnects stakeholders' pressure, internal barriers and the adoption of pro-active environmental strategies. The analysis of the data gathered by means of a survey carried out among the Medical Directors of Italian healthcare organisations shows that the lack of commitment to environmental issues within the organisation has both a direct and indirect negative effect on the adoption of pro-active environmental strategies, while the difficulties in evaluating the changes and the impacts deriving from environmental management only moderates the relationship

between stakeholders' pressure and pro-active environmental strategies.

The second paper asks the question: *How can healthcare organisations promote professionals' engagement in pro-environmental behaviours?.* Adopting a case study methodology, the paper compares the experiences of two Italian healthcare organisations that have embraced the "sustainability journey" but have achieved opposite results in engaging their staff and leading them to adopt pro-environmental behaviours at work. Drawing on the analysis of the data gathered, the paper theorizes two main mechanisms as unit-level mediating processes between the set of organizational factors acted upon by managers and the adoption of pro-environmental behaviours by staff, which allow the organisation to introduce more pro-active environmental management practices and effectively implement them over time: *i) the emergence of Affective Commitment (AC) to environmental management (that is the employees' shared psychological alignment or affective attachment to environmental management); and ii) the creation of a strong pro-environmental climate (that is the employees' shared perception of practices,*

procedures, and behaviours that get rewarded, supported, and expected in relation to environmental management).

The third paper asks the following research questions: *i) Which "green" human resource management practices influence the adoption of collective organisational citizenship behaviours toward the environment? ii) Which is the mechanism through which "green" human resource management practices influence the adoption of collective organisational citizenship behaviours toward the environment?.*

The paper examines the direct and indirect impact that "green" competence building, "green" performance management and "green" employee involvement practices have on collective Organisational Citizenship Behaviours toward the Environment (OCBEs), defined as the standard mode of behaviour in the unit with regard to actions that contribute to a more effective environmental management and are directed toward the improvement of environment-related performance. Furthermore, conceptualising environmental management as an organizational change and drawing on a collective social exchange perspective, the paper proposes and provides empirical support for the role of collective AC to environmental management as mediating mechanism between the three "green" Human Resource Management (HRM) practices of interest and collective OCBEs. The analysis of the data gathered by means of a survey carried out among

the Sustainability Managers of English healthcare organisations support the hypotheses of a positive impact of "green" competence building, "green" performance management and "green" employee involvement practices on collective OCBEs, while they partially support the hypotheses on the mediating role of collective AC to environmental management, as "green" performance management practices are not found to be significantly associated with collective AC to environmental management.

The results of the dissertation make several contributions of our understanding of environmental sustainability in healthcare organisations and expand our knowledge on how promoting the adoption of pro-environmental behaviours in organisations. First, the dissertation contributes to offer new empirical evidence on the role played by internal barriers in impeding pro-active environmental strategies and extend previous knowledge providing original empirical evidence of the interplay between stakeholders' demand to protect the environment and internal barriers in shaping the pro-activity of healthcare organization towards the environment. Second, the dissertation sheds light on the implementation of successful interventions for making healthcare employees' behaviours more sustainable, allowing the organisation to adopt a more pro-active stance toward environmental management and to improve its environmental performance over time. The findings contribute to increase previous knowledge

on the attitudes affecting the adoption of pro-environmental behaviours in the organisational setting and, particularly, on the role of AC. Furthermore, the study findings contribute to expanding the literature on facet-specific organizational climates, proposing pro-environmental climate as a unit-level climate with a specific reference to environmental policies, procedures, and practices. Finally, the dissertation enriches extant knowledge on the impact of "green" HRM practices on OCBEs at the collective level of analysis. Specifically, the study findings provide new insights on the direct effects that "green" HRM practices have in enhancing employees' ability, motivation and opportunity to go the extra-mile in environmental management and shed light on the role of "green" competence building and "green" employee involvement practices in fostering employees' commitment to environmental-related changes and their actual behavioural support for environmental management activities. Altogether, the dissertation is one of the first studies that examine environmental sustainability issues in the healthcare sector and, therefore, it contributes to previous knowledge investigating environmental sustainability in a novel context and set the stage for future studies on environmental sustainability in healthcare organisations.

QUALITATIVE MODELING OF A DYNAMIC SUSTAINABLE MASS CUSTOMIZATION BUSINESS MODEL

Golboo Pourabdollahian Tehran - Supervisor: Prof. Marco Taisch

For the last decades Mass Customization (MC) has been considered as a proper strategy for the markets characterized by the heterogeneous needs of customers. MC is usually considered as a win-win strategy that benefits both customers and companies. On one hand, customers can have the opportunity to create their own desired product to satisfy their individual needs while having the unique experience of co-design. On the other hand, firms can charge higher prices for customized goods because of the increased willingness of customers to pay for individualized goods while producing them at cost levels that are comparable to those of mass produced goods thanks to flexible manufacturing processes and suitable customer interaction tools. Subsequently, customers would be more satisfied and profit margins of the company would be higher. However, it might not be sufficient to assess the MC strategy solely on the basis of economic indicators. Environmental problems and the exacerbating climate change have sparked a global debate about ecological thinking and sustainability. Customers' demands for more environmentally friendly products on one hand, and tough regulations by

governments on the other hand bring out the concept of sustainability as a point of attention for companies. Nevertheless, when it comes to environmental impacts of Mass Customization, things are less clear and more challenging. The current research was triggered observing a gap in the literature regarding linkage of Mass Customization and environmental sustainability. This study intends to target the problem of bridging Mass Customization and Environmental sustainability, particularly by basing it on two main gaps in the MC literature: 1) Lack of a holistic business model for successful implementation of MC 2) Evaluating the performance of such a MC business model in terms of Environmental Sustainability. This research aimed at coining the new taxonomy of "Sustainable Mass Customization (SMC)" and developing a model to support MC companies in successful pursuit of the SMC strategy. Consequently, in the first part of the study, a MC business model and an environmentally sustainable business model have been developed based on both theoretical and empirical data. Thereafter and during the second part, the developed MC business model

was translated to a qualitative dynamic MC business model applying the principals of System Thinking and System Dynamics. Eventually based on empirical data, the impact of the MC business model on environmental sustainability was identified and the final qualitative SMC business model was developed. The results of this study can benefit MC companies that intend to improve their level of MC performance while having an eye on enhancing their environmental sustainability performance as well. The final SMC business model enables these companies to configure their tailored SMC business model and become more eco-friendly without distracting them from their core business of Mass Customization. This study contributes significantly to both theory and practice. In terms of contribution to knowledge the study:

- Provided a taxonomy of the current state of the art of Mass Customization and Sustainability and highlighted the open research streams in the body of literature of each concept
- Developed a framework to link open research streams of MC and sustainability and suggested 17 new research direction which can be

- investigated by academia
- Coined the new term of "Sustainable Mass Customization" as a new strategy which can be followed by MC companies
- Developed a holistic MC business model by collecting and classifying data from the literature and case studies
- Analyzed and identify the potential environmental impacts of a set of MC enablers using empirical data from both academia and industry
- Integrated the systems theory with Mass Customization and sustainability by applying the principals of System Thinking and System Dynamics in the development of the SMC business model
- Developed a conceptual model to visualize the links between MC enablers and MC /sustainability KPIs
- Developed a qualitative SMC business model to depict how MC enablers affect the level of environmental sustainability. The model can be used by other academicians as a reference for further improvement and develop a quantitative SMC business model
- In terms of practical contribution, the study has two main contributions:
- Provided a conceptual tool for MC companies to

support them in successful configuration of their MC business model

- Provided a conceptual tool for those MC companies that intend to enhance their environmental sustainability performance to configure an optimum MC business model that lowers the environmental impacts of the company without compromising the level of MC.

The outline of the study is designed in three main phases precisely defined namely Context analysis & Conceptualization, Design & Development, Formulation & Validation. To cover all the phases, the thesis is divided into 7 chapters. Chapter 1 presents an overview and brief introduction of the study by defining background, motivation and expected contribution of the research. In chapter 2 a critical review of the existing body of literature in terms of MC and Sustainability is presented closing with a number of open research streams for each concept. The chapter ends with a proposed framework illustrating the existing open areas and research topics in the field of Sustainable Mass Customization. The framework is used to define and target the main research gap and research problem of the

study. Chapter 3 is dedicated to describing of applied methodologies in different stages of research. Research objectives, hypotheses and questions are articulated in this chapter. Moreover the designed phases of research and the related theoretical framework are presented in Chapter 3. The first core chapter of the study is Chapter 4 where the structure of the business model is defined. The chapter continues with the development of two separate business models, one for MC and the other for Environmental Sustainability using both theoretical and empirical findings. Chapter 5 is focused on bridging two developed MC and sustainability business models by finding their mutual links and come out with a single SMC business model. In chapter 6, the applicability and usability of the developed SMC business model are examined are by carrying out a case study analysis. The thesis is closed by a final chapter of conclusion where a summary of findings is being presented and discussed. In addition limitations of work and the potential future works will be defined.

APPLYING AGENCY AND STEWARDSHIP THEORIES AT THE INTER-ORGANIZATIONAL LEVEL: the case of the social housing sector in Italy

Francesco Rizzitelli - Supervisor: Prof. Giuseppe Catalano

Structuring effective contractual relationships is a critical factor for the success of organizations. How should the principal select, incentivize and control a manager to ensure that she properly performs a service on his behalf?

The most widely used theory to frame contractual relationships is agency theory. The principal and manager are assumed to be moved by different goals. The manager is a self-interested actor who attempts to pursue his own goals at the expense of the principal. To ensure that their goals are aligned, the principal writes contracts based on economic incentives and penalties linked with the manager's performance and develops control systems to monitor the manager's behavior. While agency theory is the dominant framework, some scholars have suggested a different approach to characterize contractual relationships. The hypothesis is that not all managers are self-interested; instead, they can also adopt pro-organizational behavior and have goals aligned with those of the principal. In this scenario, a manager requires trust and autonomy, monetary incentives do not determine his behavior and control can be counterproductive. This is the framework of stewardship

theory.

Initially, scholars regarded the two frameworks as mutually exclusive. Relatively more recent studies have suggested that they be used in concert and identified psychological and situational factors such as leadership, motivation, identification, moral development and so on that make one theory more effective than the other. However, while these factors have been well defined at the individual level, less work has addressed instances in which the principal and manager are organizations. Specifically, two gaps in the contemporary literature are identifiable when the principal and manager are organizations: 1) no study defines factors that distinguish what makes an organization a steward from what makes it an agent; 2) the link between the manner in which contractual relationships are structured and performance is unclear.

To fill these gaps, contractual relationships are analyzed in the Italian social housing sector. Specifically, this thesis addresses three research questions: 1) how do the manager's characteristics affect its behavior (is it more of an agent or a steward)? 2) How are contracts structured and managed? 3) How do the manager's characteristics and contract rules affect service

performance?

The Italian social housing sector represents an appropriate context to answer the research questions: it is a social sector open to both nonprofit and for-profit organizations that have significant differences with respect to goals, size, governance mechanisms, and so on.

The analysis is conducted through multiple case studies on a period of five years (2008 – 2012). Particularly, seven case studies are selected: the municipality of Bologna, Florence, Genoa, Milan, Sesto San Giovanni, Turin and Venice. For each case, manager's characteristics, contractual rules and performance are studied. Findings confirm that managers' behavioral strategies are more complex than a simple agent-steward dichotomy would suggest: the analysis of goals and the verification of their alignment or misalignment with those of the principal is not sufficient to say that the manager is a steward or an agent, respectively. However, having goals aligned or not, considerably affects manager's behavior. In this sense, we can use the expression "potential steward" to indicate a manager whose goals are aligned with those of the principal and "potential agent" when such situation is not verified.

Nonetheless, other variables determine a behavioral shifting. Specifically:

1. legal status affects manager's behavior. Public organizations tend to behave as stewards while privates as agents. Among the former, no difference emerges between for profits and nonprofits. This result, however, is affected by the lack of private nonprofit organizations in the sample;
2. how size affects manager's behavior depends on the initial manager's starting situation. In detail, whether the manager is a potential steward, the bigger the organization, the more it behaves as an agent. Conversely, whether the manager is a potential agent, the bigger the organization the more it behaves as a steward;
3. centralized or decentralized decisional processes do not seem produce any effect when the manager is a potential agent, while the more the organization is decentralized, the more it behaves as agent in case of potential steward.

As concerns the contractual rules, the analysis shows that tools suggested by both theories are utilized, even though not always coherently. Finally, results show that neither manager's characteristics nor contract rules alone offer a comprehensive reason of manager's performance. Instead, the manner in which these two dimensions are matched is more explanatory. Generally, it is the degree of contractual efficiency that impacts on performance. If contract relationships are not structured in accordance with the manager's behavior, performance is low. In this

sense, two forms of inefficiency are provided by the empirical analysis. The first occurs when principal and manager begin their relationship in different position. For instance, the principal wants to structure a principal-agent relationship with a manager steward-like. Such inefficiency, however, can be surmounted over the time. The principal and manager are two dynamic entities that interact and modify their behavioral strategy until they find a point of equilibrium. The second form of inefficiency, instead, is more dangerous and occurs when the principal decides to structure a certain relationship, but it doesn't use all tools to develop it. The principal prefers a principal-agent relationship, but it does not foresee appropriate control mechanisms; at the opposite, the principal declares the will to structure a principal-steward relationship but he exacerbates the control or does not involve the manager in the decisional process. Though theoretically both principal-agent and principal-steward relationships can produce high performance, the former are more difficult to implement in the social housing sector because the sector shows a high degree of complexity. This work is one of the few applications of agency and stewardship theories at the inter-organizational level. Three are the main contributions from a theoretical point of view:

1. the attempt to extend and reconcile the two theories, defining organizational and relational variables that lead an organization to behave as agent or steward;
2. the elaboration of an

innovative model for verifying the degree of efficiency in the contract relationships;

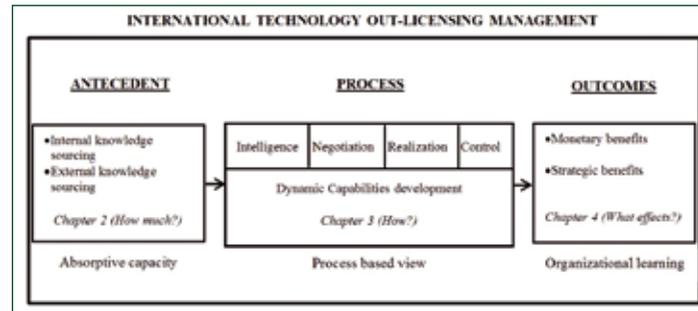
3. the first attempt of application of the two theories to the social housing field. The work has interesting implications also for practitioners. The results have provided further evidence that social services, in this case social housing, have to be managed carefully because of their intrinsic degree of complexity. Not all managers can be selected, but rather only those show a more steward-like tendency. Obviously, the work represents a starting point; additional studies are needed in order to confirm our findings and additional variables may be explored for better classifying managers as steward or agent in different context.

TECHNOLOGY OUT-LICENSING INTERNATIONALLY: A HOLISTIC VIEW

Uros Sikimic - Supervisor: Ing. Federico Frattini

The objective of this PhD dissertation is to study the antecedent and organizational level implications for managing international technology out-licensing. In the modern business context it is especially relevant to observe international technology out-licensing, as it presents an important mean for extracting both monetary and strategic value of firm's intangible assets, which account for more than 50% of the market value of an enterprise. To achieve this goal this PhD thesis is made as a collection of three research articles that are mutually linked together to build a cohesive report on the research topic of interest and offer a holistic view of it. Each of the articles constitutes one of the chapters for this paperwork. In terms of methodologies, this dissertation balances between the statistical analysis through longitudinal data studies and a multiple case study approach. The unique contribution of this study is the fact that both the technology management and international business literature are combined together for the purpose of examining the over-boarder technology out-licensing. By doing so, we put forward a holistic view of the topic.

By considering the literature review given in **Chapter 1**, a set of research constructs and



1. Schematic representation of research framework

relationships giving an overview of over-boarder technology out-licensing was proposed. In each of the corresponding chapters that follow it is explained why a particular research question is in focus. The rationale behind the developed research framework (shown in Figure 1) is that in order to achieve successful international technology out-licensing the main three elements that cover this activity should be cautiously understood and managed, starting from the international out-licensing antecedent (antecedent construct), throughout international out-licensing process (process construct) and towards the desired outcome (outcome construct).

Next part of the thesis empirically assesses the propositions coming from the research framework above. Research paper reported in

Chapter 2, titled "Antecedent of International Technology Out-Licensing Volume: Does Technology In-Licensing from Abroad Help?" analyzes the volume of technology in-licensing from abroad as an antecedent of international technology out-licensing volume. Two research questions were raised here, one dealing with the effect of in-licensing volume from abroad on out-licensing volume internationally, and the other one looking at the moderating effect of the internal R&D intensity. We find a positive influence of technology in-licensing from abroad on technology out-licensing internationally. Moreover, the positive moderating effect of internal R&D intensity on this relation has been recognized. In terms of the thesis development, this paper adds a contribution on the antecedent side of international out-

licensing because it highlights technology in-licensing from abroad as a valid contributor to the magnitude of the organization's technology out-licensing internationally. It looks at the enablers of international out-licensing leading to the next step - a focus on the international technology out-licensing process itself. So, the results given in this chapter allow us to proceed towards a more comprehensive view of technology out-licensing abroad.

Chapter 3 presents an article titled "Managing International Technology Out-Licensing: A Process Based View and Dynamic Capabilities Development". We aimed to disentangle the "how to manage technology out-licensing abroad" question. The key findings in this study indicate that: companies adopt the process view perspective for managing technology out-licensing abroad, and throughout the stages of this process firms tend to develop their Dynamic Capabilities. Empirical data for this study was gathered through a multiple case study of the leading Italian pharmaceutical and biotech companies. Research findings from this article contribute to a deeper understanding of technology out-licensing in foreign markets in technology management and internationalization literature, by integrating the elements coming from these research streams. Managerial implications from this paper may be especially useful for firms operating in the research intensive industries, enabling them to recognize relevant issues

around international technology out-licensing process. Finally, this study is an important link between the question on out-licensing antecedent and strategic outcomes following it. Research article titled "Learning through Technology Out-Licensing Internationally: Organizational Learning and Influence on the Product Commercialization" reported in **Chapter 4**, focuses on the strategic outcome as a benefit of international out-licensing. In this study we observe how international technology out-licensing affects product commercialization success abroad, by applying an organizational learning theory and testing the propositions on a panel data set from the Spanish manufacturing sector. We find that companies develop more successful products when they out-license. In particular, we show that the time lag window between out-licensing and the learning effect is also relevant. These findings are meaningful in the context of the thesis framework and add on the bulk of research that deals with the strategic outcomes from international technology out-licensing. Findings presented here help theoreticians and practitioners to fully understand the nature and mechanism of these strategic outcomes. In **Chapter 5** the general conclusions from the thesis are elaborated. First, in terms of theoretical implications this paperwork indicates that the higher ability for explaining and understanding international technology licensing-out is achieved when threatening this phenomenon as an intersection

of technology management and international business research. Second, out-licensing should not be treated as an isolated strategy in the firm. For its optimal management researchers should view it jointly with new product development strategy, internationalization strategy and innovation strategy. By doing so, its use in both the product and technology market would be more structured. Finally, some critical issues surrounding this business activity have been raised in this PhD dissertation, which is a step towards a holistic view of international technology out-licensing. This research project holds valuable implications for managers, especially in the current business environment where knowledge presents the leading competitive advantage. In fact, technology out-licensing has been repeatedly emphasized as a valuable strategy to achieve higher financial and strategic profits from technological assets. This dissertation provides a number of managerial solutions (e.g. learning from out-licensing abroad) that suggest proficient ways to carry out technology out-licensing activities. Novel consequences at the macro-economic and societal level could be as well enabled by global technology exchange (e.g. technology transfer to underdeveloped countries), all alluding on the importance for further studies within this topic.

THE ROLE OF PILOT PROJECT IN THE ADOPTION OF OPEN INNOVATION: A THEORETICAL FRAMEWORK AND AN EMPIRICAL ANALYSIS

Riccardo Terruzzi - Supervisor: Prof. Davide Chiaroni

In recent years the green tech industry is where the most R&D investments are focused (compound annual growing trends +10% in last 5 years). New approach to innovation management are therefore implemented and tested by green tech firms in order to develop new products and remain competitive on the market. The use of the historical approach to innovation management, based on high investment in own R&D facilities, is no longer sustainable. Open Innovation was an emerging paradigm since its first appearance in innovation literature in 2003. From that moment firms from every sector have tried to adopt this approach and exploit its benefit. Scholars suggested the use of a pilot project to first introduce Open Innovation principles in a firm. Green tech industry with its peculiarities is now interested in implementing this innovation approach to develop new products required by the market. How a firm in green tech industry should adopt Open Innovation through pilot project is no longer discussed in literature.

Understanding how a firm could implement Open Innovation approach through a pilot project is the primary objective of this research. Literature

analysis allows us to identify a main existing gap on the process of adoption of Open Innovation and on the transfer of developed knowledge about Open Innovation from a project to the entire firm. The phenomenon-driven objective and the state of theoretical knowledge on the topic, suggest that a theory-building research approach is needed for the purpose of this study. We used a preliminary theoretical framework to gather information during the empirical analysis. The aim is to identify the main concepts and variables underlying our analysis. This led to the definition of one main research question: **"How firms could use (design, manage and exploit) a pilot project in order to adopt Open Innovation?"**

According to the theory-building approach and the complexity characterizing the green tech industry, the use of rich qualitative data is crucial. Firstly, we studied the green tech market in Italy and we identified the most innovative firms in order to build our sample. This requires several direct interviews and panel studies. We built a sample of 10 green tech firms that had attempted to change their innovation approach. We selected firms on the basis of a "polar types" sampling

procedure. Then, data were gathered through around 30 direct interviews with key informants through the use of multiple investigators. Multiple case studies answer to RQ and led us to define several propositions which represent the emerging theory that can be tested in subsequent research.

Four are the main step in which a pilot project should go through: (i) the conception of the project, (ii) the realization, (iii) the transfer of project results and (iv) the setting of new procedures.

The conception and realization of the pilot project serve the purpose to establish a sense of urgency for changing a firm's approach to innovation and to put into test, in an isolated and risk-free context, protected from the pressure of everyday business activities, a number of alternative practices and approaches that can be used to develop new products, services and processes under an Open Innovation approach. The role of top management is pivotal in forcing the approval of the pilot project and to overcome the inertia to changes. It also strongly influences the team composition and partners involved. The pilot project is run by a small team organized and treated internally as a dedicated

and separated organizational unit. The Intellectual Property Office assumes a new role and it is in charge of the potential selling of developed knowledge (new products, process or services) instead of simply protecting it.

The transfer of project's result to the parent organization is the stage of the pilot project where inertia to change is first challenged and initial attempts are made to introduce into everyday business processes the Open Innovation principles, which are tested and demonstrated on an experimental basis during the pilot project realization. During this step the project team is made permanent and the project leader becomes the champion of the transfer process. Established internal R&D unit is the major source of resistance to the new approach.

Then, during the setting of new procedures, the new approach for managing innovation under an Open Innovation philosophy becomes institutionalized in the whole organization. This is the last phase when all these new approaches and procedures developed during the pilot project are made permanent by fine tuning them and by replacing the old ones. The creation of strong relationship

and synergies among the functions of the firms is required to institutionalize the procedures and the approaches tested during the pilot project. The task of the newly created permanent team is to manage an independent network of potential innovation sources. Firms adapt their organizational procedures for the evaluation of new ideas, explicitly taking into account the potential for external in-sourcing of innovation. Firms also adopt a new performance measures explicitly aimed at evaluating innovation activities under an Open Innovation perspective.

This research is relevant from a theoretical point of view contributing to the current discussion among scholars about how implementing a shift toward Open Innovation in practice. It is believed that this work can benefit research in the innovation management field. Firstly, the study integrates existing literature in the field of innovation management, organizational change, project management and knowledge management in order to develop a conceptual framework which identifies the steps that a pilot project should go through. Secondly, according to the developed framework, the research determines whether and how

firms could use a pilot project for a successful transition to Open Innovation. In this analysis the research points out several variables of interest for each step of the project. Each variable is discussed and the actual knowledge on how to manage a pilot project for the adoption of Open Innovation is extended.

First of all, it is to remember that the aim of this thesis is developing an emerging theory about the use of pilot project to adopt Open Innovation that needs to be further tested and validated on an extensive empirical basis. Considering the problems that R&D managers and Chief Technology Officers are confronted with when it comes to change their firm's approach to technological innovation from a Closed to an Open philosophy, this research is believed to hold valuable implications. The rich empirical basis, that is discussed, provides R&D managers the organizational and managerial solutions already implemented in the most innovative firms. Therefore, it gives several indications about how design and put into practice the pervasive change process from Closed to Open Innovation.