

MECHANICAL ENGINEERING | PHYSICS |
PRESERVATION OF THE ARCHITECTURAL
HERITAGE | STRUCTURAL, SEISMIC
AND GEOTECHNICAL ENGINEERING |
URBAN PLANNING, DESIGN AND
POLICY | AEROSPACE ENGINEERING
| ARCHITECTURAL COMPOSITION |
ARCHITECTURE, BUILT ENVIRONMENT
AND CONSTRUCTION ENGINEERING |
ARCHITECTURAL, URBAN AND INTERIOR
DESIGN | BIOENGINEERING | DESIGN |
ELECTRICAL ENGINEERING | ENERGY AND
NUCLEAR SCIENCE AND TECHNOLOGY |
ENVIRONMENTAL AND INFRASTRUCTURE
ENGINEERING | INDUSTRIAL CHEMISTRY AND
CHEMICAL ENGINEERING | INFORMATION
TECHNOLOGY | **MANAGEMENT ENGINEERING**
| MATERIALS ENGINEERING | MATHEMATICAL
MODELS AND METHODS IN ENGINEERING



Head:

Prof. Paolo Trucco

DOCTORAL PROGRAM IN MANAGEMENT ENGINEERING

INTRODUCTION

The Doctoral Program in Management Engineering (DRIG) offers students advanced training and preparation to conduct research in the field of management, economics and industrial engineering. It aims at training professionals who are able to carry out high-quality research in the fields of management, economics and industrial engineering at universities or other research institutions. PH.D. graduates from DRIG are also well equipped with distinctive skills and advanced knowledge to pursue a professional career in manufacturing and service companies, regulatory authorities and other public bodies. The program allows the student to develop a sound methodological background and multidisciplinary knowledge by attending courses designed to provide a multiplicity of visions, theories and approaches, a broad cultural panorama. The program emphasizes the benefit of studying problems in an innovative manner, combining various analytical approaches and research methodologies. The commitment of the Department of Management, Economics and Industrial Engineering (DIG) to research and scientific cooperation with other academic institutions, major industrial companies and other organisations results into an ideal environment in which for students to acquire leading-edge knowledge and cultivate their own research interests in a broad range of research subjects.

PH.D. PROGRAM STRUCTURE AND CONTENTS

The Full Time doctoral program covers three years, whereas the Executive Program lasts four years. They are entirely taught in English. The Faculty of DRIG includes, in addition to professors of the Department of Management, Economics and Industrial Engineering, several international scholars: Rodney Turner, Editor of the International Journal of Project Management; Mike Wright, Imperial College London, UK; Irvine Lapsley, University of Edinburgh, UK; Hans De Bruijn, Delft University of Technology, The Netherlands; Abraham B. Rami Shani, California Polytechnic University, USA; Christopher Worley, University of Southern California, USA; David Coghlan, Trinity College Dublin, Ireland; Donald Huisingsh, University of Tennessee, USA; Tobias Kretschmer, Ludwig-Maximilians-Universität München, Germany. The program covers three main types of training activities.

Main courses

- Mandatory courses in Epistemology of Research in Social Sciences and Academic Publishing.
- Methodological courses, addressing specific research methodologies and related skills relevant to research in management, economics and industrial engineering;
- Thematic courses, aiming at introducing students to the reference theoretical background and the cutting edge research in specific disciplines, such as Entrepreneurship and Entrepreneurial Finance, Innovation Economics and Management, Supply Chain Management, Organisational Theory and Design, Service Operations Management, Enterprise and Operations Risk Management, Sustainability and Social Challenges in Industrial Systems.

Elective courses and training on specific themes

Elective training activities are customised according to the specific needs and research interests of students. The aim is to strengthen the scientific knowledge of students in very specific topics and to introduce them to the international research community through their active participation to international scientific conferences and PhD schools.

Thesis

The aim of the PhD programs at Politecnico di Milano is to instil in candidates a research-oriented mind-set, along with expertise and skills relating to a specific research topic. To develop a research-oriented mentality, candidates must acquire the ability to solve complex problems, including a thorough analysis of the problem, identification of an original solution and the ability to evaluate the solution and its applicability in given contexts. PhDs who possess these abilities will have greater opportunities for advancement in research positions, both in the academic environment as well as in public and private organisations. The main goal is the development of an original research contribution. The Ph.D. thesis should help increase knowledge in the applicant's research field. It also needs to be consistent with the research topics studied at the Department. The final thesis can be submitted in the form of either a monograph or an edited compilation of papers. The research projects presented in the following section are typical examples

of the research work carried out by DRIG students.

SCIENTIFIC AND INDUSTRIAL COLLABORATIONS

Students are required to spend at least one semester in a foreign research institution. In addition, students are encouraged to attend doctoral schools and workshops organized by other institutions and to participate in international scientific conferences. The presentation of an original research work in an international conference is mandatory for admission to the final exam. To his end, students are granted of a personal research budget, covering a three years research period, and have access to mobility support measures aimed at promoting international collaborations between the doctoral programs in Europe and overseas. In addition, Double Degree agreements are in place at the PhD level:

- EDIM (European Doctorate in Industrial Management, www.edim-phd.eu) is an Erasmus Mundus Joint Doctoral Programme run by KTH (Sweden, Co-ordinator), POLIMI (Italy) and UPM (Spain) and is funded by the European Commission (EACEA);
- Other Double Degree Programs (4 years): Pontificia Universidad Católica de Valparaíso (Chile), Copenhagen Business School (CBS, Denmark), Henley Business School (HBS) at the University of Reading (UK)

DRIG has also developed several research collaborations with private manufacturing and service firms, regulatory bodies, and other public research institutions to fund PhD oriented research. In recent years, the following organisations supported DRIG Scholarships: Value Partners, TXT e-solutions, IBM, Siemens, Telecom Italia, Windesheim University of Applied Sciences, Fondazione Brescia Musei.

PROFESSIONAL OPPORTUNITIES AND THE JOB MARKET

Typical career opportunities opened up by the doctoral program include:

- Post Docs, research fellows and young lecturers at Italian and foreign universities;
- Researchers and scholars in Management Engineering at public and private organisations;
- Highly qualified personnel at research and training institutions, or at technology transfer centres in

- Italy and abroad;
- Professionals at leading management and strategic consulting firms who can provide deep and advanced insights into companies' business areas;
- High-level professional roles at national and international public institutions;
- Managerial roles at multinational companies with a strong focus on innovation;
- Entrepreneurs in contexts characterised by a high level of innovation.

Support actions for placement are provided with the purpose of sharing experiences, services and information through a number of initiatives fitting the different types of career opportunities. Particular emphasis is given to career development in the Management Engineering area.

ADVISORY BOARD

| Name | Affiliation |
|------------------------|---|
| Punam Sahgal | Vice President (HR), National Institute for Smart Government, India |
| Wayne W. Huang | Dean School of Management, Xi'an Jiaotong University, China |
| Maryam Alavi | Dean Scheller College of Business, Georgia Institute of Technology, USA |
| Valerie Suslow | Associate Dean, Johns Hopkins Carey Business School, USA |
| Joahn Roos | Chief Academic Officer, Hult International Business School, UK |
| Mats Engwall | Head of Division of Industrial Management, KTH Royal Institute of Technology, Sweden |
| Georg von Krogh | Chair of Strategic Management and Innovation, ETH, Switzerland |
| Reinhilde Veugelers | Professor of Managerial Economics, Strategy and Innovation, University of Leuven, Belgium |
| Martin Schader | Associate Director of Quality Services, EFMD, Germany |
| Carlo Purassanta | Country General Manager of Microsoft Italy, Microsoft, Italy |
| Aldo Fumagalli Romario | President and CEO, SOL S.p.A., Italy |
| Andrea Pignataro | Founder & CEO, ION Trading, Italy |
| Giuseppe Falco | CEO, BCG Italy, Greece and Turkey, Italy |
| Laura Frigenti | Director of the Italian Agency for Development Cooperation, Italy |
| Melissa Peretti | Country Manager Italy, American Express, Italy |
| Elena Zambon | Zambon President, Italy |
| Matt Symonds | Business School Media Consultant and Rankings Expert, France |

THE DISTINCTIVE MANAGERIAL CHALLENGES OF SOCIAL HYBRID VENTURES: A HUMAN CAPITAL PERSPECTIVE

Farah Nabil Adel AL Taji - Supervisor: Prof. Mario Calderini

A hybrid organization is established based on more than one institutional logic to meet two different demands in the same time (Pache & Santos, 2010). In most cases those demands compete and might collide. Social ventures (SVs) are organizations established based on two logics: social and commercial. Those organizations meet the demand of creating social value for their beneficiaries simultaneously with their efforts to generate money through entrepreneurial activities in order to pursue financial sustainability (Doherty, Haugh, & Lyon, 2014; Pache & Santos, 2010; Santos, Pache, & Birkholz, 2015; Smith, Besharov, Wessels, & Chertok, 2012; Tracey & Phillips, 2007). Therefore, SVs are characterised by hybridity (Bromberger, 2011; Doherty et al., 2014; Haugh, 2007; Lee, 1937; Santos et al., 2015). Both demands of SVs are equally important for SVs to achieve social goals and financial sustainability (Alberti & Varon Garrido, 2017; Santos et al., 2015). However, the commitment to respond to both demands at the same time creates distinctive challenges when managing SVs (Doherty et al., 2014; Tracey & Phillips, 2007) such as the challenge to maintain the growth of social value as well as the economic viability (Smith

et al., 2012). In other words, the challenge to keep both missions in the core of the organization, which would ask for a capacity and human resources capable of managing both missions and avoiding the risk of mission drift (Miller, Wesley, & Williams, 2012; Pache & Chowdhury, 2012; Tracey & Phillips, 2007). Another distinctive challenge is managing the conflict that might occur when having the two demands in the core (Battilana, Lee, Walker, & Dorsey, 2012; Doherty et al., 2014). This conflict can happen between internal stakeholders who can be divided in two groups of conflict (social group and commercial group), which in turn, is expected to have an impact on the organization's identity (Tracey & Phillips, 2007). The conflict can also exist between external stakeholders who might have conflicting demands from the organization (Alberti & Varon Garrido, 2017; Santos et al., 2015). The organization will then require different competences not only able to handle this conflict, but also transform it into blessings for the organization (Alberti & Varon Garrido, 2017; Hockerts, 2015; Smith et al., 2012). Because of those distinctive challenges, SVs have the demand for human resources with a set of different competences to

embrace such challenges (Kickul, Janssen-Selvadurai, & Griffiths, 2012; Miller et al., 2012; Pache & Chowdhury, 2012; Plaskoff, 2012). However, the literature stresses that there is a lack of human resources with such competences to effectively manage SVs with hybrid nature (Battilana et al., 2012). Therefore, an issue in the hiring process (Battilana et al., 2012; Bruneel, Moray, Stevens, & Fassin, 2016) has also been raised as a consequence for this demand and for the lack of potential employees with previous knowledge and experience at hybrid organizations. In order to address the lack of potential employees with previous background at hybrid organizations, two ways were proposed in the literature. First one is social entrepreneurship (SE) education. This education is meant to target students of the management and business schools to equip them with the required knowledge and competencies to manage hybrid organizations with two competing demands (Plaskoff, 2012), this is a way to provide future managers for such organizations. Second, the literature opined that having a homogenous team at organizations with two institutional logics would bring the different competencies needed to manage

the two logics and demands; however, it is still unknown if a homogenous team performs better than a heterogeneous one (Beugré, 2016; Doherty et al., 2014). Business and management schools' interest in offering SE education has significantly increased in 2014-2015 compared to 2004-2005 (Spais & Beheshti, 2016). Pache and Chowdhury (2012) stressed that SE education is still new and "suffers from a lack of clear theorizing". Thus, a limited number of theoretical models on how to teach or conduct training for SE have been developed and published in academic journals, and few of them were focused on the hybridity issue (i.e. Smith et al. 2012; Kickul et al. 2012; Pache & Chowdhury 2012). Nonetheless, the model developed by Smith et al. (2012), which is called the "paradoxical leadership model for social entrepreneurs", strictly connects the demand side with the supply side. The demand side is represented by the distinctive challenges occurred when managing organizations with two institutional logics, while the supply side is represented by the skills required to embrace such challenges. This model is based on the theoretical perspective of the paradox theory (Lewis, 2000), which provides astuteness about the source, nature, challenges and responses of competing demands in organizations. The model proposes an interesting set of specific skills, nonetheless, the two associated challenges do not demonstrate how the distinctive challenges of hybrid SVs might look like in practice. A

need for more specific challenges is argued to be as important to improve theorizing SE education. On a practical side, and building upon the model of Smith et al. (2012), Tracey and Phillips (2007) asked how business and management schools would respond to the different skills required to prepare managers for social hybridity ventures. On another hand, Dufays & Huybrechts (2016) have proposed, based on entrepreneurship and institutional logics concepts, that the founding team's heterogeneity with regards to education and professional experience would more likely bring hybridity to the organizations they establish. Estirn et al. (2016) also highlighted "the importance to considering heterogeneity in the effects of general human capital on both individuals' skills and preferences", this might advance our understanding on some of the reasons behind the emergence and performance of different types of organizations such as social hybrid ventures. Several studies examined the prediction of different entrepreneurial outcomes by the organizations' human capital, some popular studies were conducted by Colombo & Grilli, 2005, 2010. However, a majority of those studies were focused on traditional enterprises, while few examined the role of human capital on hybrid SVs such as Estrin, Mickiewicz, & Stephan, 2016; Rey-Martí, Ribeiro-Soriano, & Sánchez-García, 2016; Scarlata, Zacharakis, & Walske, 2016. This work seeks to fill the lack of human resource issues in existing

research at social hybrid ventures by exploring the two propositions stressed in the literature, this work:

- i) Extends the paradoxical leadership model of Smith et al. (2012) by exploring how the distinctive challenges of social hybrid ventures look like in practice, whereas specific challenges are elicited from an empirical study and then associated with the specific skills proposed in the model.
- ii) Evaluates the SE education taught at all Italian universities based on the specific skills suggested by Smith et al. (2012) model, which would advance our understanding on whether this education is capable of preparing human resources able to manage the distinctive challenges at social hybrid ventures. On the other side, this work is also intended to learn from the Italian case, with respect to the employed pedagogical tools there in order to contribute to the model of Smith et al. (2012).
- iii) Provides empirical evidences to respond to the poorly addressed question, especially by quantitative studies of the emergence and performance of hybrid organizations (Scarlata, Zacharakis, & Walske, 2016), doing so by studying the impact of the heterogeneity of the founding team at social hybrid ventures on the emergence and performance of such organizations.

PRODUCT CIRCULARITY ASSESSMENT: A METHODOLOGY TO GUIDE MANUFACTURING TOWARDS MORE CIRCULAR PRODUCTS

Cecilia Maria Angioletti – Supervisor: Prof. Marco Taisch

Growing resources' depletion and value dissipation caused by current production-consumption models need attention. Industry holds a role of responsibility in the way in which inputs are transformed into economically valuable outputs, and how products and resources are managed along their lifecycle to ensure value maximization through their retention. As a result, it is also responsible for economic losses for businesses and for the negative burden on social and natural systems. This research investigates the challenges faced by the Circular Economy in being adopted as a new development model for manufacturing systems. Particularly, this thesis tackles the issue of the adoption of Circular Economy practices and principles at product system level. The objectives are to provide companies with a methodology to realize products that are more circular, starting from the assessment of the current products' performance of circularity at operational level (resources consumption) and supporting them to define actions for improvement. The work started with a review of the existing methods and tools for the evaluation of products' circularity performance and their

criticalities highlighted the need for further research. Therefore, a theoretical framework (*Product Circularity Assessment Methodology*) to define measures of circularity at product level was proposed. The circularity performance of a product is strongly related with the ability of adopting CE theoretical notions such as CE principles and integrating CE practices within the current business activities. The analysis of existing knowledge brought to the identification of CE principles and practices from related fields (e.g. industrial ecology and symbiosis, sustainable development, natural capital, biomimicry, green and blue economy and performance economy). From this analysis, calculations (CPA Metric) were designed to capture the circularity performance of a generic product based on the characterization and path of the resource flows (materials and energy) within the product system of reference. The final output is the product circularity indicator (CPI), resulting from aggregated indexes of materials and energy circularity along the product life cycle phases. To test the methodology, experts were interviewed and principles and practices refined. The calculations were validated through several prototypes and

finally applied to two industrial cases, respectively in the transport and medical sectors. In order to support the manufacturers in improving the current circularity performance of their products, an improvement methodology (*Circular Economy Transition Methodology*) was developed to provide structured process for the identification, analysis and prioritisation of interventions. The levers to overcome the obstacles that currently prevent the occurrence of circularity are extrapolated from the review of the literature and proposed, after theoretical validation with experts in the field, as standard tactics for improving the circularity of products. The improvement methodology was applied to the industrial case in the transport sector. The contribution to knowledge of this work is enclosed in bridging the gap between theoretical concepts for Circular Economy and industrial activities by developing a methodology to assess the performance of circularity of products and providing tactics and standardised processes for improvement. From a practical viewpoint, the research provides a structured and systematic approach for manufacturers to undertake the journey towards more circular products by

improving the management of resource flows at product system level.

Keywords: Circular Economy, Circular Manufacturing, Circularity Indicator, Product Lifecycle

ENGINEERING AND PRODUCTION ALIGNMENT IN ENGINEER-TO-ORDER SUPPLY CHAINS: THE STRATEGIC ROLE OF THE TWO-DIMENSIONAL CUSTOMER ORDER DECOUPLING POINT IN THE MACHINERY INDUSTRY

Violetta Giada Cannas

Supervisors: Prof. Margherita Pero; Dr. Jonathan Goslin

In engineer-to-order (ETO) supply chains the customer order decoupling point (CODP), i.e. the point where the customer penetrates, separating forecast-driven and order-driven activities is located at the design stage. Consequently, each new customer order requests ETO companies to perform a significant number of engineering and production work after the order. For this reason, customisation has always been considered the primary key success factor for ETO companies, which positively affects customer willingness to pay and wait for ETO products. However, the recent literature has underlined that customisation is no longer the only source of competitive advantage. The current price competition in global markets, combined with the increasing customer requirements for high variety in short lead times, is pushing ETO companies to find ways to increase efficiency while keeping high flexibility. Therefore, ETO companies are facing a trade-off: to reduce lead time and increase cost efficiency often implies to reduce product and processes customisation, by performing a certain number of activities before the customer order. Consequently, the literature recommends increasing

coordination between the engineering and production processes to make them work together since the early design phases, and increase efficiency by avoiding late unexpected engineering revisions, expensive production reworks and delays. To achieve this aim, the movement from ETO to mass customisation is suggested, working around the alignment of engineering and production activities by implementing techniques such as modularity and product platforms. This strategy encompasses diverse order fulfilment strategies and its successful application depends on identification of the optimal point of initial customer involvement, i.e., CODP positioning, in the engineering and production processes. Unfortunately, most studies in the CODP literature takes mainly into account the production dimension, rarely including the engineering phase and distinguishing it from the production phase. For this reason, the traditional CODP framework has been defined as not sufficient for supporting ETO companies. To overcome the problem, a new CODP concept has been introduced in the literature, which includes the possibility to apply engineering adaptations to customer orders:

an extended two-dimensional (2D) CODP framework to study the combination of engineering and production decoupling decisions that better reflect real-world issues. In this field, the literature is still highly immature and there is a significant gap between theory and practice. Therefore, this thesis targets the study of the strategic role of the 2D-CODP for the engineering and production alignment in ETO supply chains. In particular, this study aims to theoretically develop a single framework for classifying and comparing the different strategic choices of 2D-CODP positioning within ETO companies and empirically test and validate the framework in the machinery industry, answering the following research question: *RQ1 (WHAT) - What are the order fulfilment strategies employed by ETO companies?* Moreover, the study purpose is to theoretically study and empirically observe the application of managerial approaches in different 2D-CODP positioning, answering the following research question: *RQ2 (HOW) - How does the order fulfilment strategy employed by ETO companies influence their approaches to manage and coordinate engineering and production activities,*

upstream and downstream of the CODP? Finally, the thesis addresses the exploration and test of contingency theory in the 2D-CODP field to theoretically classify and empirically identify the contextual factors affecting 2D-CODP positioning and the dynamics of the alignment to the different environments, answering the following research question: *RQ3 (WHY) - Why do ETO companies choose different order fulfilment strategies?* This study draws on the CODP and ETO literature to develop a theoretical framework based on contingency theory as a theoretical foundation. Based on the combination of the relevant studies identified in the literature, the order fulfilment strategy is supposed to depend on the contextual factors characterising the market, product and process characteristics. Then, through research using exploratory multiple case studies in the machinery industry, the thesis validates and extends the theoretical framework, emphasising the importance for companies to implement the order fulfilment strategy that best fits the contextual factors and achieve the expected performance outcome, thanks to the support of the right set of managerial approaches. Answering to RQ1, the results obtained show that ETO companies employ different order fulfilment strategies, which involve different degrees of customisation in both the engineering and production activities, mainly addressing mass customisation approaches, i.e.,

a combination of flexibility and customisation and efficiency and standardisation in both the engineering and the production processes. Answering to RQ2, the outcomes of the research highlight that the order fulfilment strategy influences the focus of ETO companies on different priorities to manage activities upstream and downstream of the CODP. The higher the number of activities performed upstream of CODP companies, the higher the efforts of employing managerial approaches to assure design and material availability as well as engineering and production coordination; whereas, the higher the number of activities performed downstream of the CODP, the higher the efforts of employing managerial approaches to assure engineering and production capacity and capability as well as their coordination. Finally, answering to RQ3, the findings of the study emphasise that the order fulfilment strategies choices of ETO companies can be either a consequence of companies adapting their strategies to fit existing environments (e.g. because of natural growth of the previous technologies and/or changes in the customers' characteristics) or can be a choice of companies to strengthen specific competitive priorities and achieve definite market positioning (niche, dominant, strong, follower or stable). In conclusion, from a scientific perspective, this thesis: (1) contributes to the theoretical debate on ETO and decoupling thinking applications to engineering and production

processes, overcoming the ambiguous CODP definitions and the lack of an overall common structure in the theory of decoupling points; (2) enriches the current literature on approaches to manage and coordinate pre and post 2DCODP operations, that, until now, has mainly focused on either the production or the engineering process, with the interfaces between production and engineering; (3) explores contingency theory in the 2D-CODP literature, by studying the contingencies driving the choices of 2D-CODP positioning, which have still not been systematically addressed in the literature. From an empirical perspective, this thesis: (1) reduces the gap between theory and practice providing cases that exemplify the practical application of the 2D-CODP framework to actual cases and adapting the framework to the machinery industry; (2) supports practitioners to choose the optimal approaches to manage and coordinate engineering and production processes, upstream and downstream of the 2D-CODP, depending on the order fulfilment strategy employed; (3) enriches the current understanding of what companies should do when they face changes in their external or internal environment and need to align the order fulfilment strategy in order to achieve the desired performance.

TECHNOLOGICAL CHANGE AND MANUFACTURING JOBS: ECONOMIC AND SOCIETAL IMPLICATIONS

Paola Maria Fantini - Supervisor: Prof. Marco Taisch

Automation is deeply transforming the economy, life and society. Manufacturing historically represents a significant share of GDP and employment in Europe and in other developed countries.

Understanding the interdependencies between technological change and human work is extremely important in order to anticipate the impact on jobs and prepare policy makers, individuals, organizations towards a sustainable future, from an economic and social perspective.

This thesis work has addressed the overarching goal of increasing the understanding of the coevolution of technologies and jobs in order support industrial companies, workers and other stakeholders in the transformation towards Industry 4.0. To this purpose three specific objectives have been addressed.

- 1) Study and interpret the past: investigate the interdependencies between automation and manufacturing jobs;
- 2) Explore the future: foresee the skills needs for manufacturing jobs within Industry 4.0;
- 3) Support the present: develop frameworks and methods to support industrial companies in designing manufacturing jobs.

The thesis has lead to the following main conclusions:

- 1) A quantitative analyses of the coevolution of industrial robots and jobs in five countries with the highest robot density shows that, depending on the context, competition is not the only type of relationships between robots and workers. In some countries, but not in Italy, these two populations have also achieved a successful cooperation.

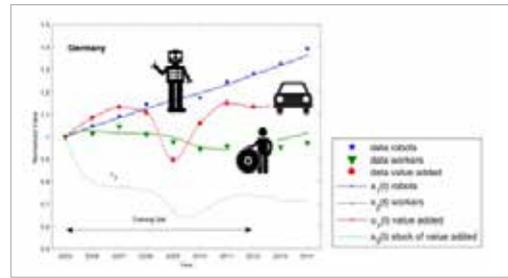


Fig. 1 - Dynamic model of the interdependencies among robots, jobs and value added, Germany 2005-2014

- 2) Skill gaps or skill mismatches are, among the others, factors that may hinder economic growth and occupation. A structured repository of 129 skills for Industry 4.0, achieved through a foresighting process, is proposed for enterprises to selectively identify and assess their skill needs, and for institutions and other stakeholders to support the definitions of policies as well as education and training programs.

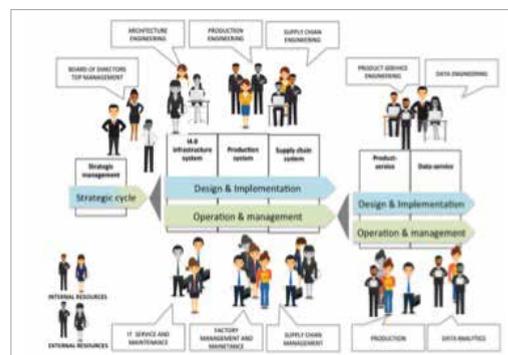


Fig. 2 - Structured repository of 129 skills for Industry 4.0

- 3) Work design requires novel approaches to enable the successful cooperation between humans and technologies, while considering

the complexity of the manufacturing systems within Industry 4.0. The methodology, conceptual framework and key performance indicators, developed in this thesis, allow to jointly consider the human uniqueness and the powerful contribution of cyber-physical systems together, within the material, digital and holistic nature of the work context. The application to an aerospace and a compressor manufacturer cases illustrates the results of the methodology in providing feedback to work design thus improving human integration and better aligning the strategies for automation and human resource management.

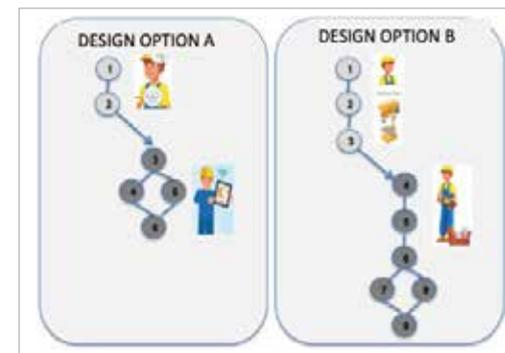


Fig. 3 - Work design methodology application to an industrial case (extract)

Overall this research work has investigated the theme of technological change and manufacturing jobs at different levels: from the sectorial level of manufacturing to the micro organization of a specific role; leveraging on several and diverse streams of literature, including labour economics, automation, social cyber physical systems; using quantitative and qualitative research methods, employing analytical modelling and simulation,

foresighting, conceptual development, and industrial application cases.

Together all the results presented and mentioned in this thesis contribute to increase the knowledge necessary for preparing the skills and designing workplaces, in which the human centric role would be recognized and exploited for both sake of worker wellbeing and stakeholder return of investment

DETERMINANTS OF INNOVATIVE ENTREPRENEURSHIP AND THE ROLE OF POLICY INTERVENTIONS

Emanuele Giraudo - Supervisor: Prof. Luca Grilli

Over the past two decades, innovation and entrepreneurial activity are topics that have received a great deal of attention in scholarly literature. Startups and Young Innovative Companies (YICs), especially those operating in the technologically advanced sectors, have attracted the interest of scholars, policy makers and also of other important actors of the modern economies.

Since Schumpeter's seminal work (1912), innovative entrepreneurship is deemed to be a major source of innovation, qualified employment and economic growth, and a large body of the following literature has enlarged the knowledge about this specific type of firm. Startups are typically characterized by their ability to develop and transform technical innovation into innovative products and services. Moreover, there has been a growing interest on the role of entrepreneurial activity for the economic and social development, and the existing literature has highlighted a positive correlation between entrepreneurial activity and welfare improvement (Audretsch et al., 2006; Carree and Thurik, 2003).

However, the most recent entrepreneurship literature argues that it is not the number of new startups that matter for

the enhancement of economic development, but rather than the positive impact is closely tied to high-growing startups (Grilli, 2014). As a consequence, over the last decade, a debate had risen among scholars, policy makers, and practitioners around the determinants of new ventures performance, and therefore how institutions and governments can support the rise of high-growing entrepreneurship. Different instruments have been designed and implemented to create a more favourable environment that can increase not only the level of entrepreneurship but more importantly its quality. Even if a very strong scientific debate has centred on the question of better policy interventions to put in place, scientific literature has not provided comprehensive and clear guidelines on identifying the best mechanisms tailored to each specific institutional context (Taylor, 2016; Wagner and Sternberg, 2004).

In this respect, firms' growth is a complex phenomenon, describable through idiosyncratic factors that are rather complicated to describe and determine (Penrose, 1959). Startups and YICs growths clearly follow a specific set of rules and different scientific lenses and methodologies have been embraced by scholars

to analyse the phenomenon. In this perspective, there are several studies that have tried to identify the fundamentals of entrepreneurial growth (Gupta et al., 2013). For example, Grilli (2014) presents a heuristic firm's growth model for New Technology based Firms (NTBs) which frames the causal inputs of growth. In doing so, the author identifies three fundamental building blocks which influence the growth process: knowledge capital, financial resources and complementary assets. Even though there are numerous publications in this field, there is still a dearth of empirical studies on how these firms grow and what the influencing factors are, especially within a specific geographical context that lacks high-growing innovative new ventures.

Relying on extant conceptual and empirical literature on the determinants of high-tech entrepreneurial venture growth, in this thesis I have analysed in a unique institutional setting - i.e. the Italian context - three specific aspects which are universally recognized as critical for innovative new ventures growth: the human capital characteristics of the founding team; the role of founders' human capital endowment in attracting talented joiners; and the effectiveness of

a policy interventions devoted to alleviating YICs' financial constraints.

Main results

the first part of the study disentangles how the reduction of entry and growth barriers to entrepreneurship impact different types of individuals to enter. Furthermore, it investigates if (and how) the combination of the human capital of the founding team and the entry/growth incentives introduced by the law, influence entrepreneurial performance. The results show that policy interventions designed to reduce barriers to entrepreneurship increase the propensity of individuals with high human capital to become entrepreneurs. Furthermore, the empirics indicate confirmation that individuals endowed with a high level of human capital are found to be more prone to become entrepreneurs after the growth reform was introduced. Interestingly, the results show that the growth reform only impacted founders with high specific human capital, while no significant influence is found for the ones with high generic human capital. Finally, the results support the hypothesis that removing growth barriers through an institutional reform increases the difference in terms of growth between innovative ventures founded by individuals endowed with high specific human capital and those with low specific human capital. The second part of the thesis investigates the relationship between founders' characteristics and the likelihood of attracting

non-founding employees. It draws mainly on resource-based theory, examining first the relationship between both founders' human capital - in particular their previous entrepreneurial experience - and motivations and the presence of non-founding employees in the venture. Second, it adds a new layer of complexity to the analysis by investigating whether and how the innovation intensity of the startup affects these relationships. Finally, it builds on the recent discussion on human capital sorting in startup settings (see for instance Honorè and Ganco, 2016; Rocha et al., 2018). In a nutshell, the results show that entrepreneurial teams endowed with greater prior entrepreneurial experience - are more likely to hire in early stages, especially in more dynamic contexts characterized by higher investments in R&D. The empirics fail to find similar support for two other dimensions of entrepreneurs' human capital though (managerial experience and education level). Furthermore, the analysis is complemented by also considering the role of entrepreneurs' motivations to found, and the results show that necessity triggers can propagate entrepreneurs' disadvantages relative to their opportunity-driven counterparts by damaging their ability to attract talent. Moreover, the analysis confirms the existence of a positive sorting between entrepreneurs and employees. The third part of the thesis focuses on the effectiveness of different policy instruments which at the same time and in the same institutional context on the reduction of young

innovative companies' (YICs) financial constraints. In particular, it investigates the possible interrelationships between the access to a Government-guaranteed (GG) bank loan program and the fiscal incentives for venture capital (VC) equity investments. The results indicate two relevant facts. Firstly, they indicate the presence of relevant differences among YICs in terms of access to the two different financial resources and the underlying policy interventions. More specifically, GG bank loans show a relatively higher propensity than VC investments to flow towards very early stage small-sized companies. On the other hand, results related to the Substitutability vs Complementarity analysis point to the presence of a substitution effect. Once backed by a VC, a YIC is less likely than before to access a GG bank loan. In conclusion, these results point to a sort of "institutional division of labour" between the two policy measures under investigation, and the presence of a Task segmentation effect. Moreover, the access to a type of financing reduces the chance to obtain the other form.

CROSS BORDER B2C E-COMMERCE TO CHINA: INVESTIGATING LOGISTICS SOLUTIONS UNDER UNCERTAINTY

Maria Giuffrida - Supervisor: Prof. Riccardo Mangiaracina

1. Research problem and motivation

Over the past 30 years, China has undergone drastic changes in its economy and society which have turned it into the most promising developing nation. Today China is also the first e-commerce market in the world, valued at over €1000 billion in 2018, and with a market share of almost 40% of global e-commerce. Such figures signal China is probably the most attractive market and, due to the stagnation of the West, represents an important investment opportunity by companies from all over the world. Moreover, e-commerce is possibly the most effective channel to reach China. Since 2013, Cross Border E-Commerce (CBEC), i.e. the process of selling online from abroad, has rapidly grown, due to supportive policies simplifying most of the bureaucratic aspects of internationalisation. However, the Government has then started to discuss the introduction of a new regulatory and tax regime in 2016. The announcement of a change in regulation has produced a great amount of uncertainty regarding the future of CBEC. Still, CBEC has other complexities, including communication in a foreign language, payment currency, payment terms, legal and tax

conditions, compatibility between online payment systems. One of the greatest challenges in this field is logistics, due to long distances and delivery times, quality of delivery, higher service level expectations, returns management, and stronger dependence on local service providers. All these considerations make apparent that China is as much attractive for international sellers as it is, at the same time, difficult to understand and approach.

2. Research objectives

The overarching goals of the project are to identify, model and analyse possible configurations of the logistics solutions supporting CBEC to China and to assess the impact of uncertainties on both costs and service level features of each solution. The stated objectives are reached through a series of research questions, summarised below

RQ1a: *What are the main logistics solutions supporting CBEC to China?*

RQ1b: *How can the identified solutions be modelled?*

RQ2a: *What logistics-related uncertainties are faced by companies selling to China via CBEC?*

RQ2b: *Do these uncertainties change with context factors, such as company size, industry, country of origin, and type of company?*

RQ3: *What is the combined impact*

of the identified uncertainties on the logistics costs and service level of each logistics solution?

RQ4a: *Which are the most important uncertainties under different logistics solutions?*

RQ4b: *Which logistics solution should a company select based on the information collected about impacting uncertainties?*

3. Research methodology

This thesis is characterised by the implementation of several methodologies, both quantitative and qualitative. The research framework presents five main phases, namely (i) literature review; (ii) identification and modelling of logistics solutions, through interviews and an activity-based model that provides an estimation of the logistics costs for each solution; (iii) identification of logistics-related uncertain factors and influencing context variables through a survey; (iv) evaluation of logistics solutions under uncertainty by means of Monte Carlo simulations; (v) prioritisation of uncertainties and decision making by means of probabilistic sensitivity analyses.

4. Research contributions

The results of this thesis are formalised in a collection of four papers. **Paper 1** reviews the state of the art in the field of CBEC logistics to China and shapes the formulation

of the research objectives.

Paper 2 helps address the first goal of the research project. This study presents a first application of the logistics cost assessment model to the fashion industry.

Paper 3 intends to help reach the second objective of the thesis. More specifically, it identifies sources of uncertainty.

Paper 4 dives into the analysis of the impact of uncertainty on logistics. This study combines and further elaborates the evidence contained in Paper 2 and Paper 3, completing the picture and fulfilling the second objective of the thesis.

5. Results and conclusions

The answers to the research questions addressed by this thesis are summarised below.

RQ1a: *What are the main logistics solutions supporting CBEC to China?*

Based on this research, four main solutions are identified, depending on the transport mean and the presence of logistics nodes in China: (1) solution "S+W" (ship + warehouse); (2) "P+H" (plane + hub); (3) "P+W" (plane + warehouse); or (4) "D" (direct distribution from the home country).

RQ1b: *How can the identified solutions be modelled?*

This question has been addressed by building an activity-based model that considers the main logistics activities, namely transport, inventory management, handling, and calculates related costs in the food and fashion industries. To consider service level features of the examined solutions, also the stock-out cost is calculated and for each solution.

RQ2a: *What logistics-related*

uncertainties are faced by companies selling to China via CBEC?

By relying on the extant literature, we hypothesise that the risks faced in CBEC are a combination of those faced in global logistics and e-commerce logistics environments, given that CBEC merges the two phenomena. We find that the main risk factors are delivery uncertainty, service uncertainty, demand uncertainty, compliance uncertainty, external uncertainty, product damage, stock-related uncertainty

RQ2b: *Do these uncertainties change with context factors, such as company size, industry, country of origin, type of company?*

We observe that some uncertain factors are associated with the context variables industry membership, type of company, country of origin, and company size. However, the tested relationships are weaker than initially hypothesised.

RQ3: *What is the combined impact of the identified uncertainties on the logistics costs and service level of each logistics solution?*

In order to determine the effect of uncertainty under the four logistics solutions, simulations are run on the results with all uncertain inputs varying together. Uncertainties in the values of the inputs affect logistics solutions differently depending on the industry.

RQ4a: *Which are the most important uncertainties under different logistics solutions?*

Regulation change is the most influential variable. Following, the convenience of each solution is dependent on the type of product. Third, service level is relevant in

every solution. Fourth, uncertainty in demand is a key parameter especially for solutions not relying on local logistics infrastructures.

RQ4b: *Which logistics solution should a company select based on the information collected about impacting uncertainties?*

The thesis answers this question by proposing a decision tree approach, calculated for the cases of the food and fashion industry. We find that generally uncertainty does not affect the optimality of the "S+W" solution in the food case. For the fashion case, instead, the optimal solution is dependent on the probability of the single direct shipments being checked and taxed.

6. Implications for theory and practice

This research takes an important step forward in the CBEC literature, which is still fragmented. This study, positioned at the intersection of e-commerce logistics and global logistics, allows to extend some of the concepts and findings of these fields to the more recent topic of CBEC. This study has also important implications for practice. The whole project is characterised by an empirical approach, thanks to its connection with the Digital Export Observatory. Finally, from a policy point of view, the thesis stresses how promising yet challenging CBEC in China is, identifying in unclear and ever-changing customs or legal procedures some of the biggest sources of uncertainty in this field. Trying to correctly shape interventions that support the development of the sector has become of crucial importance.

OPENING THE BLACK BOX OF MATERIAL CRITICALITY: HETEROGENEITY AND INTERRELATIONS OF COMPANIES WITHIN AND ACROSS INDUSTRIAL SECTORS

Yulia Lapko - Supervisors: Prof. Paolo Trucco, Prof. Cali Nuur (KTH)

Research background

For centuries, natural resources (such as minerals) have been core prerequisites for industrial competitiveness and prosperity of nations. However, rapidly growing world population and increasing demand from newly industrialised countries raise concerns about availability and accessibility of natural resources. These concerns led to introduction of the concept of 'material criticality' and development of 'material criticality analysis', the instrument for identification of problems that might arise over the access to resources. Throughout the last century, different materials have been considered as critical due to changes in technologies and economic development trends, changes in supply and demand structures, in political conditions etc. Nowadays, the materials labelled as critical have particular impact on emerging technologies that are indispensable to abate climate change and to ensure sustainable development, such as photovoltaic panels, wind turbines, electric mobility etc. The current material criticality discourse tends to conceptualise the system under examination rather as a black box, assuming industrial sectors as homogeneous and even monolithic entities, just formally acknowledging their composition

and complexity. Moreover, industrial sectors are assumed to be independent entities, as interconnections of end-use applications of the same material are neglected. The thesis highlights that such conceptualisation is oversimplistic and problematic, as it misses to consider operational reality of companies that form and drive materials flows through supply chains, industrial sectors and geographic regions. The thesis questions appropriateness of dominated assumptions and aims to achieve the following objectives: 1) to examine the influence of heterogeneity and interrelations of companies on identification and mitigation of material criticality; and 2) to demonstrate their relevance for understanding material criticality.

Methodology

The thesis adopts exploratory approach and inductive logic for the research. This choice is driven by the lack of considerations of the company dimension in the material criticality discourse and fragmented empirical evidence. The thesis addresses the research objectives through four studies, which examine various aspects of heterogeneity and interrelations of companies and their influence on identification and/or mitigation of material criticality. The selection of empirical setting for each study

is driven by information-oriented logic: materials, companies and industrial sectors are selected in order to ensure that obtained data is suitable for the intended investigation.

Key findings

The findings demonstrate heterogeneity of companies regarding material criticality along a supply chain, within an industrial sector, and across different industrial sectors. This heterogeneity reveals important diversifying aspects of identification and mitigation of material criticality, they are: awareness and concerns of criticality factors and feasibility and relevance of mitigation actions. Interrelations of companies within and across industrial sectors influence the identification of material criticality by facilitating/impeding 'awareness' of supply disruptions, and affect the mitigation of material criticality by enabling/impairing the 'feasibility' of various options. 'Concern' and 'relevance' are elements that rather relate to strategic priorities and planning horizons of each company, and are subject to its interpretation and sensemaking. As the findings indicate, inter-/intra-sectoral heterogeneity and interrelations of companies are important aspects influencing material criticality that should

not be neglected. This highlights the importance of incorporation of the company dimension in the material criticality analysis. The findings provide implications for the importance of detailed examination of supply chain structures, buyer-supplier relations, power positions of companies against their supply chain partners and competitive positions of companies at the resource and product markets. Plethora of suggested mitigation actions indicate a great potential for mitigation of material criticality. However, companies have diverse interests and capabilities, and the same action might not be feasible for all companies. The findings provide implications for the following limiting conditions: a power position against suppliers and customers, a competitive position at resource and product markets. In addition, the findings indicate that the current frameworks of possible mitigation actions miss to consider relational and contractual instruments that are favoured by companies.

Key implications

The thesis calls for extension of the scope of the criticality analysis to include companies dynamics, employment of existing theories for development of criticality factors and empirical research for both validation of the

deduced factors and examination of new ones. In the same manner, further examination of mitigation of material criticality is required. The thesis highlights the importance of policy-makers for ensuring transparency of mineral supply chains that would allow companies to have appropriate visibility of materials flows and their impediments. Moreover, policy-makers need to provide selective support for companies and industrial sectors as well as for strategies that are currently regarded as irrelevant or challenging for companies but are important at the industrial system or global levels (e.g. closed-loop supply chain). However, given that the support of the government is important, it is not clear to which expend the assistance and guidance should be provided. The results serve to raise awareness of practitioners about material criticality and to assist with the decision-making for development of mitigation strategies. The findings warn against development of own equivalent of material criticality assessment methodology by companies because of their selective consideration of influencing factors and primary focus on own supply chain and industrial sector. Given that the material criticality analysis is under development,

companies are encouraged to contribute to its development by bringing empirical evidence and indications for relevant factors and feasible mitigation strategies. The dialogue between policy-makers, researchers and industrial actors is required in order to gain better understanding of the phenomenon.

VENTURE CAPITAL AND INSTITUTIONS

Gresa Latifi - Supervisor: Prof. Luca Grilli

Over the last two decades, the focus of entrepreneurial finance research on venture capital (VC) finance has increased drastically for two main reasons. The first reason concerns VC's prominent role in promoting microeconomic performances to achieve firm growth and innovativeness (Kortum and Lerner, 2000; Puri and Zarutskie, 2012) and macroeconomic growth (e.g., entrepreneurship rate, employment, aggregate income; e.g., Samila and Sorenson, 2011). The second reason that the debate is still lively is related to the geographical concentration of VC activity across the space. To date, evidence has shown stark differences among developed economies concerning the level of VC activity. For example, the United States accounts for 54% of global activity (NVCA, 2017), whereas Europe's VC industry is less than one fourth compared to that of the United States (Ernst and Young, 2014; European Parliament, 2012; Florida and King, 2016) despite the attempts of the latter to mimic the success of the former. Such disparities have been subject of a long debate that produced a growing number of studies that attempted to understand the reasons behind VC's varied development. Scholars have focused their attention on developing a better understanding of the institutional determinants,

possibly identifying those that foster the birth and development of the industry and those that hamper it. However, for focusing mainly on macroeconomic conditions or an array of regulations (e.g., Black and Gilson, 1998; Jeng and Wells, 2000), these studies have been criticised for taking a one-sided perspective; both the formal and informal institutional features of a country were revealed to be responsible for economic activities (North, 1990; Peng et al., 2009; Williamson, 2000). For example, previous studies hardly encounter the role of informal institutions and the mechanisms through which such dimensions demonstrate their impact on VC activity across geographical areas. Social capital, as a fundamental informal institution for entrepreneurship development and innovation (Brüderl and Preisendörfer, 1998; Dakhli and De Clercq, 2004), is almost totally overlooked when it comes to assessing its role in shaping VC industries across countries (for an exception, see Hain et al., 2016). This demonstrates that scientific discourse sorely misses a comprehensive systematisation of knowledge that reflects what we know and what we do not yet understand about the institutional determinants of VC activity, in addition to, as defined by North (1990), a rigorous empirical

examination that tests the specific formal (e.g., rules and regulations) and informal (e.g., cultural norms and codes of behaviour) institutions that either alone or in interaction with each other happen to influence VC activity. Moreover, little is known about the equity gap (VC and business angels [BAs]) along both its two dimensions: the demand and the supply side. The business plan (BP), which is widely discussed as an important selection criterion encountered by professional investors when they make their decisions, could play an interesting role for addressing the equity gap (i) from the demand side, as it may associate with the readiness level of entrepreneurial teams, and (ii) from the supply side, as it can make the investors more confident to invest. To put it differently, there is a need to better understand the actual role of such an instrument, which in the past has been evidenced to play a significant role in the realisations of these investor–investee dyads (Hormozi et al., 2002; Karlsson and Honig, 2009). To fill not only this last gap but also the others mentioned before, more research is needed. Therefore, this thesis hopes to contribute to entrepreneurship, entrepreneurial finance, and institutional research by addressing these problems and by including the role of the context in which VC activity takes place. In doing

so, the thesis aims to explain the differences of the VC market's development among different geographical areas as well as to understand better the role of BP on the functionality of entrepreneur–investor dyad. This overarching goal is reached by reviewing existing literature dealing with the institutional determinants of VC activity, then empirically testing the impact of specific formal and informal institutions on VC development while finally examining the role of BP as an instrument that may impact the realisations of investor–investee dyads. The extant research offers little scientific evidence or a systematisation of knowledge that might allow us to determine the current state of the art with regard to VC activity. There are several studies that have measured the role of institutions and other contextual determinants of VC to understand the causes of the disproportional levels of VC activity around the globe (e.g., Armour and Cumming, 2006; Bedu and Montalban, 2014; Bonini and Alkan, 2012; Gompers and Lerner, 1999). However, these studies have not been listed and observed in detail so as to understand the degree to which the studied institutions matter for VC activity to take place. A comprehensive systematisation of these studies is, therefore, needed to catalogue and better comprehend the reasons given for the sufficient presence of the VC industry in some countries and its deficit in others. In addition, this activity will allow us to organise a concrete research agenda that informs the scientific spectrum about possible avenues for future

research. There is also an apparent need to test the role of certain institutional dimensions because the stream of literature dealing with the institutional impact on VC activity has devoted discriminatory attention to formal institutions. More precisely, the focus has merely revolved around stock market conditions, regulations such as labour markets and tax laws, investor and intellectual property protection, or other features of the environments where the activity takes place (e.g., Black and Gilson, 1998; Jeng and Wells, 2000). Very few studies actually employ the other component of North's (1990) institutional theory—that is, the informal institutions. Even fewer studies have attempted to explore the role of one formal institutional dimension under specific informal institutional structures that are present in a country. For example, the introduction of a more changeable institution such as a liberal bankruptcy law may not produce the desired effects if it is not compatible with other informal institutions that are already present because formal and informal institutions interact with each other. Shedding more light on these aspects helps governments to prioritise and to wisely draft new policies that encourage the VC industry to grow. When considering specifically the functionality of investor–investee dyad realisations, a less-explored component is the BP, which extant literature claims to have a deterministic role in helping new ventures secure financing, at least in past years. A number of researchers have pointed at this document as

one of the first things a funder (i.e., external finance provider) requires from an entrepreneur (Hormozi et al., 2002). This characteristic applies not only to debt financiers (e.g., the bank) but also to equity financiers (e.g., BAs and venture capitalists [VCs]; Hormozi et al., 2002; Karlsson and Honig, 2009; Shepherd and Zacharakis, 1999; Zacharakis and Shepherd, 2001). Both, VCs in one hand, and BAs in the other, appear to pay serious attention to a BP as well (Mason and Harrison, 1996; Shepherd and Zacharakis, 1999). Although previous studies tend to position the BP as a tool that enables start-ups to leave a remarkable impression and hence gain funding, less is known about its current relevance. Older literature (e.g., MacMillan et al., 1985) and scientific discourses that study this relationship, focusing on narrow economic contexts only (e.g., Kirsch et al., 2009), makes it difficult for us to draw conclusions that apply to the present economic reality. At the same time, these outdated studies have produced a culture that has resulted in the creation of countless costly BPs in the hopes of obtaining funding. In this way, pursuing fresh new evidence on the matter is needed. In other words, understanding whether the preparation of a BP by entrepreneurs speaks to a demonstration that guarantees them access to external finance is important. Further investigations on how the role of founders' dedication in preparing such documents impacts the realisation of investor–investee dyads is just as important.

INNOVATION MANAGEMENT IN SERVICES: THE CASE OF CONSULTING FIRMS

Isaac Lemus-Aguilar

Supervisors: Proff. Raffaella Cagliano, Antonio Hidalgo

Research problem and setting

Innovation in consulting firms has missed specific attention in academic research. Consulting firms are usually considered to be part of Knowledge-Intensive Business Services (KIBS), Professional Service Firms (PSF) or Project-based Firms (PbF). Consulting firms usually help other companies to be innovative, but they also need to innovate themselves to survive in the market. However, consultancies possess characteristics that do not correspond to generalizations made in previous studies. Some recent service innovation models have been identified but none of them focuses exclusively on service innovation in the context of consulting firms.

The research explores how firms organize to manage innovation from a process perspective as well as its relationship with innovation dimensions and capabilities. It investigated the innovation processes in the context of consulting firms based on the interaction among main actors identified during the literature review from an internal (management, employees) and external (customers, competitors) perspective. In a lesser extent, other studies have also pointed out the role of other actors

such as suppliers, competitors, universities, government, and society. Nonetheless, companies struggle to implement the best innovation strategy and innovation processes based on the wide range of options above mentioned. Companies tend to simplify reality by trying to control one single linear innovation process, but in fact, there are several innovation processes running at the same time. It is true that each of this innovation processes are generally related with one of the perspectives. Our results show that all these views are not mutually exclusive; on the contrary, many of them coexist or evolve into the other along the lifecycle of the company and its business circumstances.

Methodology

To achieve the research objective, the methodology follows three steps. Initially, a semi-quantitative literature review was conducted to get familiar with the state of the art in the field, identify gaps and draw a preliminary framework about the innovation processes in consulting firms. After that, a qualitative research strategy was used based on case studies. The first phase of the study was conducted in consulting firms from

Italy between June and September 2015. The second phase of Study was realized in consulting firms from Spain between April and June 2016. We contacted around 60 companies via the university external relation offices, LinkedIn and personal networking. We selected companies from all ranges that had important projects and operation in both countries. In total, 15 consulting firms participated in our study (7 from Italy and 8 from Spain).

Contributions

There are three main contributions of this research. First, there are some peculiarities in the management of innovation in Professional Service Firms. Consulting firms have the challenge of using a mix of seven innovation processes as a solution to the strategic problem of innovation management, which are related to seven different drivers and sources of knowledge. PSF primary focus on innovating new services concepts and new technological delivery systems in an initial project with a client which are rather customized than standardized when this knowledge is reused to provide a solution to another client. Consulting Firms create new practices not only to provide new

service offerings (operational capabilities) but also to adapt and renew their innovation capabilities (dynamic capabilities). Signaling user needs and co-producing and orchestrating are the main dynamic service innovation capabilities that distinguish consulting firms.

Second, IT Consulting Firms manage innovation different when compared to Management Consulting Firms. Consulting Firms cannot be treated as an undifferentiated group. We distinguish at least two subgroups: IT Consulting Firms, which share more similarities with the T-KIBS, whilst Management Consulting firms are more similar to P-KIBS. Evidence suggest that IT Consulting firms have a more mature implementation of open innovation compared to Management Consulting Firms. IT Consulting Firms focus on the development of innovation ecosystems changing their role from problem solvers to solution seekers.

Third, the use of Open Innovation for Innovation Management in PSF. Due to nature of the service provision (co-production/ co-creation), consulting firms have always used open innovation processes because it allows them to have organizational

ambidexterity. Exploration is done through the customization of a solution to the client, while the exploitation is performed by initially standardizing a solution to be later customized again when applied into another client project. This research also proposes a taxonomy of outbound open innovation strategies.

UNWARRANTED VARIATIONS IN HEALTHCARE: THE ROLE OF BUSINESS INTELLIGENCE

Sina Lessanibahri

Supervisors: Luca Gastaldi, Camino González Fernández

Healthcare is one of the most impactful sectors, affecting strongly all aspects of the society ranging from medical services to social, governmental, business, and economic implications. Currently, there is an emerging concern of chronic diseases, the ageing and higher mobility of care professionals, which accentuates the need for national policies to enhance the availability, approachability, eligibility and quality of the care system. These changes are driving the cost of healthcare to unsustainable levels. On the other hand, it is well known that healthcare systems suffer from service delivery variations known as unwarranted variations. These are the variations that are not explained by patients' needs or preferences. Existence of such variations indicates that the best care has not been delivered or that resources have not been appropriately deployed in healthcare organizations. These variations can occur in terms of treatment quality, expenditure, supply of health resources, etc. Detecting and reducing these variations is one of the main paths to decrease the healthcare expenditures without compromising the care quality. The correct identification of the unwarranted variations is

the corner stone to detect the underlying factors and designing effective interventions to reduce the disparities. The proper detection of the unwarranted variations has two important antecedents: first, timely access to quality data and second, reliable risk adjustments. As not all variations are unwarranted, risk adjustment methods are used to separate the "good" variations from the total observed variations. These aspects are even more crucial when moving from larger to smaller levels of analyses. We believe that Business Intelligence (BI) is a prominent remedy for both of these vital elements. BI as a system that encompasses data collection, storage, analyses and reporting, has significant potentials in providing timely and quality data for unwarranted variations research. Moreover, BI can incorporate novel advanced analytics to better separate unwarranted variations from the total observed variations. However, literature reports that the success rate of BI in healthcare is significantly lower compared to other sectors. In order to cope with the above challenges, five studies categorized in three phases are developed in this PhD thesis. In the first phase, the

cross-regional variations in healthcare performance in Spanish provinces are assessed, examining patients' average length of hospital stay, mortality rates, readmission rates and hospital-acquired infection rates. The crude rates for the indicators have been obtained from the administrative data acquired by Spanish public hospitals, for non-surgical patients diagnosed with diseases in six Major Diagnostic Categories. These rates have been adjusted for gender, age, type of admission, severity of the condition and case-mix weights. The adjusted rates have been used as the input for a two-step clustering process, splitting the provinces into three groups based upon their performance. The results demonstrate that the clusters perform differently for mortality, average length of hospital stay and hospital-acquired infections rates, while they perform similarly for readmission rates. Moreover, the performance pattern by type of diagnostic category is similar for all the three clusters. While evidence in the literature regarding the adverse effects of length of stay reduction on readmission and mortality rates are mixed and inconclusive, our findings demonstrate that many regions in Spain can shorten the length of

stay without risk of such advert effects. Similar performances across the diagnostic categories suggest that influencing factors are common and healthcare decision-makers should pay more attention to indicator-specific interventions rather than disease-specific ones. Next, we focused on the factors influencing potentially avoidable hospitalizations. The adjusted hospitalization rates were assessed for three common ambulatory care sensitive conditions -known to be responsible for potentially avoidable admissions-. The adjusted rates of the 17 Spanish autonomous communities were collected for the period between 2007 to 2015. Fixed effect model is fitted with the data that mitigate the bias caused by time-invariant omitted or unobserved factors. The findings show that consultation with general practitioners per capita is associated with less hospitalization rates for all three conditions. Moreover, specialists' consultations per capita and the proportion of people visiting specialists is associated with reduced hospitalizations in two of the conditions. This is an indication that primary care cannot solely be held accountable for all preventable hospitalizations.

In the second phase, we developed a comprehensive maturity model that suggest the priorities to be followed for progressively developing a BI solution. Through collaborative research in several Italian hospitals, we demonstrated that the successful implementation of BI is an evolutionary and complex path. By developing a maturity model specific for BI in healthcare, we provide managers with means that guide this evolutionary implementation. We identified a comprehensive set of BI dimensions and indicators that should be considered during the implementations. Finally, in the third phase, we focused on advanced analytics that can be embedded in the BI systems and support the investigations in unwarranted variations. We first developed a novel Association Rules Mining (ARM) algorithm named Length-Sort that can discover the maximum-length association rules more efficiently. The efficiency improvement enables the analysis of larger health datasets. Next, we demonstrate the application of Length-Sort on England Quality and Outcome Framework (QOF) dataset which contains general practices' performances in terms of various evidence-based

indicators. Our results show that ARM and in particular, Length-Sort can be an explorative alternative to the traditional risk adjustment method, which can be used in health policy and unwarranted variation research as a hypothesis generation tool to detect performance patterns especially, in the more granular levels of analyses.

TECHNOLOGY STEERING: DISCOVERING QUIESCENT MEANINGS IN TECHNOLOGIES

Stefano Magistretti - Supervisor: Prof. Claudio Dell'Era

Technology offers more opportunities than the one envisioned by first adopters. This is the central assumption that motivates the entire research. Indeed, today's market is characterized by a vast variety of technologies and companies are struggling in understanding the real potentialities of each of them. To mention a famous worldwide example the MEMS technology developed by ST Microelectronics was introduced in the market in the '80s, but only in 2007, it found a real meaningful application field. Meaningful application field is a sector that allows the company to really exploit value generated. The introduction of the sensor in the electronic consumer goods allowed a completely different experience that enabled a completely different gaming experience. This is just one of the several examples that show how technology sometimes is more meaningful if adopted in different application fields rather than in the initial one. In the case of the MEMS the first field was automotive for safety reason. In the technology management literature, a lot has been said about how to manage the evolution of technology, but little is known on how to envision since the early stage of development the hidden potentiality of it. For

this reason, the research aims at enriching the knowledge on how companies can manage the technology development to unveil quiescent meanings. Given the complexity of the topic and the broad scope of the investigation, three different research questions have been framed pertaining to the finding, experimenting, and integration moments of technology development. Moreover, the three questions are linked to a theoretical framework proposed, which maps the evolution of research in the technology management field, and suggests further research in terms of more openness and broader development processes. As the thesis mentioned, the literature on technology development is suggesting that more should be discussed about how to find new application fields in order to let the technological innovation flourish. When technology is under development little is known about how to select among the different possible application fields the one that can create more value to the user. Moreover, if the value driver is not just the economic one but the meaningfulness of the field identified more investigation are needed. Indeed, the academics reported how usually developers

adopt more a converging and substitution perspective in developing technology rather than a more divergent perspective. These theoretical evidences brought to the formulation of the first research question as follows: RQ1: How can tech companies find different meaningful application fields for the selected technology? Moving to the second phase, the experimenting one, literature reports several gaps that should be investigate. First of all, experimentation is becoming a common tool for managing innovation in both small and large enterprises despite this little is known about how companies can adopt it to unveil opportunities inside technology. In the last decade scholars defined different approaches to manage this iterative and less structured innovation process. Notwithstanding this little is known on the applicability of them on the technology development. Moreover, the existing literature is reporting how iteration between ideation and testing of solution is fundamental for reducing uncertainty but despite this more insights are needed on how this impact the technology development. In addition to this if the driver of experimenting is the discovery of new meanings hidden inside the technology unanswered

questions are still present. This aspect is especially relevant when the technology is emerging. Accordingly, the second research question is framed as: RQ2: How can tech companies experiment with the opportunities hidden in emerging technology leverage the development of different meaningful application fields? Finally, the last phase is the integration one. Also, in this case the literature is showing that there is space for further investigations. As reported the integration is the moment in which the technology is adapted in order to be introduced in a final application. In particular in the latter little is known on how companies can unlock the potentiality hidden inside the technology. This is mainly due to the fact that the integration into meaningful applications is not guided by an in-depth user analysis as defined in the past by the user-driven perspective. Accordingly, a better knowledge of the skills and managerial practices that companies should adopt in order to integrate the technology is needed. Despite this, little is known regarding how to design robust technology that can cross different application. So, the last research questions that addresses these gaps is: RQ3: How can tech companies integrate the technology into a meaningful application? In order to contribute to this debate, five different articles have been crafted. The reason for this is because the first aims at better understanding the literature on technology development while the remaining four are empirical studies. So, the first is a systematic

literature review article. It spotted how the overarching development is divided into three sub-streams defined find, experiment and integrate. Following this division, three exploratory paper have been proposed in order to shed lights individually on each of this three moments. In particular two of them are already published while the third is under review. Moreover, two are purely case study-based leveraging both primary and secondary sources while the third is a mixed methodology study. Finally, the fifth paper, the fourth empirical, is a more a perspective piece. Indeed, it is trying to investigate, throughout a single in-depth case study the entire process of development and it is also linking the technology development stream of literature with the growing field of design thinking. Consequently, the result of the collection of these five papers is mainly twofold. First, it contributes to the on-going academic debate on technology management by enriching the knowledge on the evolution of technology in order to discover quiescent meanings. Second, it shed lights on the processes and approaches that companies can follow in order to unveil hidden technological opportunities. This process of discovering quiescent meaning in technology has been described as technology steering. Indeed, it is not a technology substitution process, where the technology is introduced in the field to replace a previous version without changing the reason why of the adoption, but it is more a continuous process. So, technology steering is

an approach toward development in which the firms try to force the development of the technology in varied application fields different from the first envisioned by adopters. Concerning the practitioner contributions, in answering the three research questions, the collection of papers enriches managerial knowledge on how to find, experiment, and integrate technologies, providing two dimensions relevant to finding meaningful application fields: spatial and temporal. Second, the three dimensions of technology development - depth, breadth, driver - inform practitioners on how to better manage experimentation to unveil quiescent meanings. Third, the three design management guidelines proposed support tech companies in unveiling quiescent meanings in technologies by considering technology as an enabling platform, building a two-sided network, and accessing new knowledge domains. Finally, the insights from the last case propose a broader interpretation of how design thinking and its mindset and approaches can support this dispersed and multifaceted technology steering process.

THE EVOLUTION OF CORPORATE SOCIAL RESPONSIBILITY STRATEGIES FOR ENERGY COMPANIES. A CASE STUDIES ANALYSIS

Francesca Mapelli - Supervisor: Prof. Giovanni Azzone

In the last decades, the phenomenon of Corporate Social Responsibility (CSR) has become a recurrent topic of discussion both in the academic world and among practitioners. As corporations have been experiencing increasing pressures to be socially responsible, CSR practices have been growing significantly. Today, a wide range of practices can be associated with the concept of CSR, thus including diversified activities ranging from environmentally friendly technologies to welfare initiatives. Still, over the decades several definitions have been associated with CSR as it is often used as an “umbrella concept”. However, all those definitions and practices share a common feature, which is the relationship with the society the company is immersed in. It means that, through CSR, companies aim to comply with the expectations society has on them. Still, the business environment is a complex context, where multiple and somehow contrasting logics exist. The institutional complexity of the business environment implies that concurrent logics may converge, thus amplifying one the other's effect, or diverge, thus dampening one the other. These institutional dynamics open up spaces for managerial actions, thus leading companies

to shape different CSR strategies, even though they are immersed in a homogenous environment. Also, companies need to be able to manage tensions that could emerge within this complexity. These considerations lead to the research objective of this work. The thesis aims to join the debate about the evolutionary path of companies in terms of CSR and sustainability strategies, by analysing drivers, underlying concurrent logics and, if present, emerging tensions, under an institutional perspective. Given the complexity of the phenomenon to be studied, the methodology applied is a qualitative one, as it allows to account for multiple and interconnected elements and to analyse their relations in depth. Through semi-structured interviews, selected case studies, taken from the Italian utilities industry, have been examined. The utilities sector has been chosen as it is highly impacted by growing social and environmental challenges. Forty interviews have been collected from five different corporations and they were recorded and *verbatim* transcribed. Thereafter, the scripts were coded by the author. The coding phase was developed partially manually and partially thanks to the support of a CADQUAS software, that has been essential due to the amount

of available data. Data analysis grounds on an institutional theoretical framework. Nonetheless, as institutional theory has been often criticized for being embedded in structural determinism for explanations, the author relied on the institutional logic approach. Data were analysed through three papers, which are complementary one to the others and, at the same time, independent. The first paper, grounding on the available literature, proposes a comprehensive framework that allows to investigate how CSR is evolving and what are the institutional pressures that drive this transition. In particular, four logics are recognized as relevant and they are: market, state, community, and profession. Further, five elemental items are identified as those dimensions along which CSR is evolving, and they stem: balancing and relationships between CSR objectives, system boundaries, stakeholder engagement, collaborations and alliances, and accountability and reporting. The framework is aimed to investigate the relationship among institutional logics and elemental items, and it is applied to a single case study. The case analysis reveals three types of responses to institutional pressures and related

emerging tensions: focusing on a single prevailing logic; hybridizing practices; and decoupling initiatives. Thereafter, the framework is used to investigate the interplay of different institutional logics in a specific industry (i.e., still the utilities industry) and how these institutional dynamics lead companies to adopt different CSR strategies. To do that, three cases are selected for competing in the same context, namely the Italian utilities sector. Results suggest that the institutional interplay creates spaces for managerial actions. In particular, different CSR strategies emerge whereby logics diverge and, in some cases, also whereby they converge, due to delays. Therefore, despite being immersed in the same institutional environment, companies might reply to society's expectations with different CSR strategies. Moving from the considerations posited by the first two papers, in the third paper the framework is employed to study whether tensions emerge whereby logics diverge along the path towards sustainable business. In particular, in the literature a gap concerning the role that actors might play with this regard can be recognized. To fill the gap, three cases are selected from the utilities industry for being at different

stages along the path towards a sustainable model. Results confirm the presence of tensions emerging along the path towards sustainability due to diverging and contrasting logics. Also, the empirical analysis suggests that leaders are key players in managing these tensions, and their behaviour can be explained as a phenomenon of enabling leadership. However, their decision patterns are moderated by further influential factors, such as the ownership structure of the company. Therefore, the thesis contributes to the literature investigating the relevance of the concept of CSR by suggesting that institutional contexts are characterised by the coexistence of multiple and possibly contrasting logics. Also, the effects of concurrent logics on CSR strategic decisions are investigated to provide a relevant theoretical infrastructure to explain diversity in organisations' CSR approaches. Still, the thesis contributes to the debate about the role of the agents within these dynamics, by proposing an analysis of leaders' role in tackling multiple and somehow contrasting logics. The thesis also contributes to the literature about tensions in sustainability for business by combining it with agency theory

and with enabling leadership theory. Further, the results posited might support managers in shaping CSR strategies by providing a set of real cases, and policy-makers in defining adequate incentives systems by showing what elements need to be further developed or monitored. Nonetheless, the thesis is not immune to limitations. First, a qualitative methodology has been applied but a quantitative research would enable the study of a larger set of cases, thus increasing generalizability and objectivity of the results. Second, the thesis is mainly focused on companies operating in the utilities industry, but it might be interesting to study even other sub-sectors of the energy industry or even to compare different industries to highlight similarities and differences. Finally, further research is expected about the measurement of the appropriateness of CSR strategies due to the relevance of the topic.

MEASURING THE IMPACT OF LEAN IMPLEMENTATION ON OCCUPATIONAL HEALTH AND SAFETY THROUGH LEADING INDICATORS

Seyed Sajad Mousavi - Supervisor: Prof. Paolo Trucco

Today's companies are under tremendous pressure to perform at the lowest cost, highest quality, and fastest pace; therefore, lean has emerged as a popular management philosophy for companies to attain a competitive edge. The "lean thinking" concept has become more popular since the beginning of the 21st century in accordance with the advent of the economic crisis. Two underlying goals, cost reduction and customer satisfaction are the two primary goals that companies try to reach when developing their system. Thus, lean philosophy is perceived by a wide range of industries, from manufacturing to service sectors. Along with lean implementation, however, there is an increasing concern over occupational health and safety (OHS) at the workplace. There is concern that during lean implementation, the focus on productivity may result in health and safety issues being ignored or worsened. The relationship between lean and safety has not been clearly understood up to now. In literature, many authors claim that further research is needed to better understand the impact of lean implementation on occupational health and safety. Moreover, a more suitable approach to measure these impacts still needs to be proposed

and implemented. Previous studies on the relationship between lean implementation and OHS were mostly case studies that focus on some parts of this relationship. Therefore, a comprehensive study is lacking in this research stream. The interest of this study is to determine how lean implementation typically influences OHS performance and to propose the usage of OHS leading indicators to measure their impact. To do so, a comprehensive literature review was conducted to identify the major elements affecting OHS performance. As a result, a model was developed to introduce the antecedents of safety performance. There was also a dearth of this model in the safety literature. Along with this issue, another model was developed employing the results chain model to clearly define the safety concepts in a holistic framework. By having illustrated the model, the significance of leading indicators within safety concepts was addressed. Then, three reflective components of lean maturity were extracted from the lean literature; fidelity, extensiveness, and experience. By having all these elements, a model that illustrates the relationship between lean implementation and OHS performance was proposed. In the next step, a comprehensive

survey was conducted to gather information from industries across the world.

The findings of this survey verified the elements forming the proposed model. Finally, the analysis of the information, using SmartPLS software, indicated the importance of using OHS leading indicators to forecast and measure the impact of lean implementation on OHS performance. This thesis contributes to academic community and practitioners by showing the actual relationship between lean implementation and OHS performance. Moreover, the proposal to use OHS leading indicators to forecast and measure the lean impact on OHS performance would help organizations employ lean and safety simultaneously.

STRUCTURING RECONFIGURABILITY AS A MANAGERIAL CAPABILITY IN MANUFACTURING

Alessia Napoleone - Supervisor: Prof. Marco Macchi

Nowadays, reconfigurability has grown in importance for manufacturing firms in order to deal with ever changing market requirements or technological advances. While literature offers much knowledge on it from a technology-oriented perspective, there is a gap of knowledge from a managerial-oriented perspective: operations managers should be aware of how this capability is built; moreover, they should understand how newly available technologies enrich the reconfigurability of their manufacturing plants. This thesis focuses on the characteristics a factory should have to ensure the managerial capability of reconfigurability. To do so, literature review has been adopted as primary methods, with the twofold objective of (i) capitalizing the consolidated technology-oriented knowledge on reconfigurability, and (ii) capturing under-development knowledge on new technologies. As a main result, this thesis develops the conceptualization and structuration of reconfigurability as a managerial capability in manufacturing. To conceptualize reconfigurability, six core characteristics – i.e., modularity, integrability, diagnosability, scalability, convertibility and customization

– have been identified, exploiting technology-oriented literature. To justify their exploitation for managerial-oriented purposes, the six characteristics have been classified according to the phases of system lifecycle in which they act; moreover, their relationships have been investigated within and across production levels – i.e. workstation, system and factory levels. Overall, the conceptualization has allowed decomposing reconfigurability as a “game-of-strength” of characteristics; specifically, the “game-of-strength” consists in a network of supporting-relationships required to ensure the capability to be reconfigurable at factory level. To structure reconfigurability, further characteristics induced by new technologies have been identified and their relationships with the characteristics of reconfigurability have been justified. The structuration has allowed to envision how new technologies enrich the reconfigurability of a factory. Relying on the main result of the thesis as theoretical background, exploratory and descriptive insights from manufacturing cases have been collected in order to keep field sensitivity. These insights confirm the interest on reconfigurability from a

managerial-oriented perspective: in the analysed cases, not only the expected technological aspects have emerged; interestingly, managerial aspects of reconfigurability – intended as actions valorising the “game-of-strength” of characteristics – have been successfully implemented, showing the relevance of adopting a perspective that embraces the whole factory so to boost technological aspects themselves. Furthermore, to capture further insights for the theory developed in this thesis, an investigation focused on process industry has been done, extending the study beyond the field where research on reconfigurability has originated, i.e. discrete manufacturing. This investigation has primarily supported the conceptualization of reconfigurability. Overall, the contribution of this thesis for researchers is the extension of consolidated technology-oriented theory on reconfigurability for managerial-oriented exploitation. Moreover, the thesis aims to be one of the first contributions finding synergies between the consolidated knowledge on reconfigurability and the growing knowledge on Cyber-Physical Systems (CPSs), which are one of the most significant technological levers cited by researchers

when referring to innovation in manufacturing. For industrial users, the conceptualization and structuration of reconfigurability can be seen as a preparatory step to build a methodology supporting manufacturing firms in gaining awareness of their operational capability to be reconfigurable.

ENHANCING SUSTAINABILITY IN THE INDUSTRIAL SECTOR

Alessandra Neri - Supervisor: Prof. Enrico Cagno

The present thesis is aimed at providing hints and suggestions on how to enhance sustainability in the industrial sector. Current modes of production generally result in unsustainable socioeconomic and environmental consequences. Technological, managerial, organisational, and behavioural changes are required to make production modes more sustainable, changes that cannot be possible without a transformation of industrial processes. The transformation and enhancement of sustainability in the industrial sector should rely on the identification of industrial sustainability measures and of all factors related to the adoption process, such as barriers, drivers, and gauging of performance at the different stages of the industrial system, i.e. supply chain, according to the perspectives of all the industrial decision makers involved.

The extant literature, so far, focuses on a single factor at a time and on specific areas of sustainability, thus neither accounting for an integrated analysis of barriers, drivers, and performance related to the adoption of industrial sustainability measures, nor considering the perspectives of the industrial decision-makers

involved, at the different stages of a supply chain. More in detail, there is still the need: i) to characterise and define industrial sustainability and industrial sustainability measures; ii) to identify and characterise the barriers and drivers to and for the adoption of industrial sustainability measures, and the mechanisms acting between them; iii) for a system to gauge industrial sustainability performance; for both single firms and the supply chain all the previous aspects need to be evaluated, also understanding the different perspectives of all the industrial decision-makers involved in the adoption process of the industrial sustainability measure.

Based on literature gaps and the general state-of-the-art, the specific question of the present thesis is:
How can sustainability be enhanced in industrial firms and the supply chain?

The research question is then detailed into:

- 1) *What are the barriers to adoption of an industrial sustainability measure according to the perspective of different industrial decision-makers in a firm and at the different stages of the supply chain?*
- 2) *What are the drivers for adoption*

of an industrial sustainability measure according to the perspective of different industrial decision-makers in a firm and at different stages of the supply chain?

- 3) *How is performance gauged when evaluating industrial sustainability according to the perspective of different industrial decision-makers in a firm and at the different stages of the supply chain?*

The thesis consists of a collection of eight papers focused on models for supporting the adoption of sustainability measures in the industrial sector, at a single firm level and in the supply chain in which the firm operates and measuring performance, according to the different perspectives of the industrial decision-makers involved. The single papers contribute to the overall research by providing an analysis of the specific factors related to the adoption process analysing them from the different perspectives of the different industrial decision makers involved - i.e. barriers, drivers, performance indicators for gauging sustainability performance in firms and in a supply chain, and providing an integrated analysis of all. The framework of analysis for the single firm is reported in Figure

1; the framework of analysis for the supply chain is reported in Figure 2.

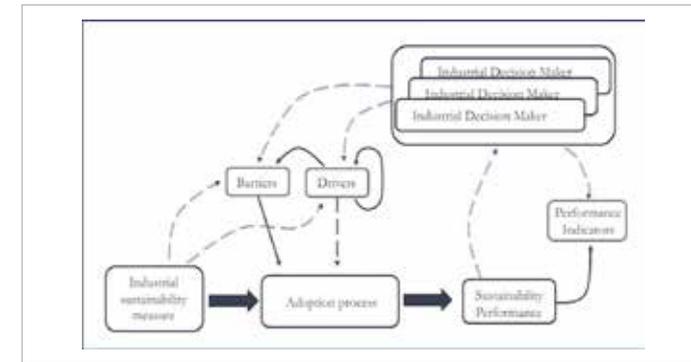


Fig. 1 - Framework for the analysis of the single firm

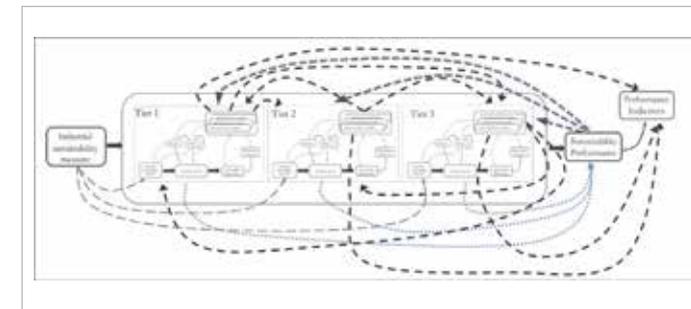


Fig. 2 - Framework for the analysis of the supply chain

The proposed research is of interest for scholars, industrial decision-makers, and policy-makers, providing them with an integrated framework for the analysis of the adoption of industrial sustainability measures in the industrial sector,

at a single firm and at a supply chain level, aiming at helping them understand the dynamics behind the adoption process. The research, overall, provides several hints and suggestions on how to enhance sustainability in industrial firms and supply chains.

HOW DO FIRMS GROW? A COMPREHENSIVE STUDY OF FIRM GROWTH MODES

Vahid Sadr - Supervisor: Prof. Massimiliano Guerini

Firm's growth has been always an important debate among both academics and policy makers. Scholars contributing to the growth literature argue that research questions addressing why there are different growth patterns among firms, how firms make decisions regarding to their growth strategies and patterns, and mechanisms by which growth can happen through, still have not received the amount of attention that they deserve. Studying the firm growth theory from the point of view of "how", is a fundamental research question that has a pivotal role in paving the path to understanding correctly, other aspects of the firm's growth both from the theoretical and empirical point of view. The first and main research objective of this thesis is to specifically focus on the 'HOW' research questions related to the firm's growth.

While many firms do not grow or grow with a slow rate, some firms grow with an exceptionally fast rate. In the literature of firm's growth these firms are referred to as fast growing firms (henceforth FGFs) or high-growth firms (henceforth HGFs) with young FGFs being called as 'gazelles'. Our review of the growth literature reveals a serious lack of a comprehensive sample of these firms in the context of Europe.

In a recent study Coad and Nightingale, (2014) enumerate six main methodological weaknesses that studies of HGFs are suffering from. Among which two of the most important weakness that lead to other methodological problems are related to the quality of the data on which these studies are conducted. In particular less comprehensive and precise data (i) leading to unrepresentative samples (ii) and consequently biased results. Following the above arguments, this thesis is structured as a collection of three papers to address and shed light on the gaps in the literature. In our first study we focus on having a better grasp of the answer to the research question of "how" firms grow (i.e., what mode of growth firms use and why). In particular, we first try to investigate the impact of VC investments on the mode of growth of investee firms. Building on VC literature we then try to disentangle the impact of IVC and CVC investments. In the second part of the paper we focus specifically on acquisitions (i.e. as an external mode of growth) to investigate the potential mediating effect of acquisitive mode of growth on the overall firm's growth. For this purpose, we consider a sample of European IVC- and CVCbacked, high-tech

entrepreneurial ventures matched with a control group of non-VC-backed firms that is extracted from VICO dataset. The most important finding of this study is that receipt of VC investment has a positive and significant effect on the likelihood of executing acquisitions as the external mode of growth. Interestingly, when disentangling the impacts of IVC and CVC investments, while the effect of IVC investment remains unchanged (positive and significant), CVC investment does not have any significant effect on the likelihood of executing acquisitive mode of growth. In our second finding we shed light on the potential mediation effects of growth mode of the firms on their overall growth performance. We investigate whether acquisitions as the external mode of growth mediates the treatment effect of IVC investments on overall growth of investee firms. The results of our analysis do not support any full or partial mediation effect on the overall growth of VCbacked firms.

In our second study, we intended to tap the undiscovered cultural and creative industries from strategic management point of view. Although CClIs could gain the attention of policy makers yet these industries have not received the attention that

they deserve from strategic management scholars. We performed an industry level analysis of antecedents of these M&A activities and the patterns of M&A formations in group of 22 CClIs in Europe. Using the lens of resource dependence theory, we try to explain how M&A activities of CClIs are effected by the resource constraints imposed by the environment. Ensuring the continuous access to the resources that are critical for the firm seems to be a challenge. This challenge can be even more complicated in the context of CClIs due to ties between these industries because of the core similarities that they have resulting from the aesthetic nature of CClIs. This implies that organic growth in CClIs are less useful in comparison to other industries and the viable means to gain access to the resources is through constraint absorption. Apart from removing constraints imposed by the environment, a natural result of this strategy is growing in size. In other words, this strategy may lead to acquisitive growth too. Thus based on this argument we expect that firms operating within CClIs use acquisitive growth not only as the main mean to absorb constraints but also as the main path for growing due to inefficiencies associate with organic growth practices in CClIs comparing to more pragmatic and utilitarian purposes of many other industries. Overall the results reveal that the acquisition behavior of CClIs can be explained by their level of dependency on their resource exchange relationships. In particular CClIs

involve in M&As in order to balance their relations. Moreover, by removing the constraint imposed by the environment in resource exchange relationships they guarantee their access to the critical resources. Finally, in our third study we focus on FGFs to shed light on the growth of such an important job creators. We investigate how differences between regulation and institutional impacts among different European countries play a role to explain and determine how to achieve faster growth. In particular, the result of our regression analysis confirms that law enforcement has a significant impact on the emergence of FGFs in our country-industry unit of analysis. The results show that countries with weaker law enforcement present less interested destinations for investors and creditors. To this end, firms will face more obstacles to finance their growth and achieve fast growth rate. However, we do not find any significant effect for investor's right. As expected, English common law has a significant impact on the emergence of FGFs. English-common-law provides high protection to the investors and consequently it is easier for firms to access to external capitals and finance their growth. Moreover, the negative and significant effect of German civil law confirms that weak protection laws will create impendent in the emergence of FGFs. Our results do not provide evidence of significant effect of French civil law on the emergence of FGFs. As expected, political stability has a positive and

significant impact, meaning that more politically stable countries provide a better environment for the emergence of FGFs. As expected, the Ease of Doing Business index has a negative significant effect as the higher values are associated with more difficulty of doing business and consequently more difficult to achieve fast growth rate. Our results represent a negative and significant effect of labor productivity on the emergence of FGFs. This reflects the fact that in highly efficient environments it is more difficult to achieve a faster growth rate. Eventually, our analysis shows that in more mature environments it is more difficult to achieve fast growth rate. Such a results prove that there is an urge for more in-depth studies of such a phenomenon in order to provide guidelines for policymakers when revising or establishing new regulation to support these firms among European countries and foster economic development.

ESSAYS ON INSTITUTING INTERNAL AUDIT AND RISK MANAGEMENT IN BANKS

Vikash Kumar Sinha - Supervisor: Prof. Marika Arena

The recent financial crisis of 2007-08 was a watershed moment in the history of banking. The unprecedented event caused severe scrutiny by governments, regulators and standard setters on how the business of banking is run. As a result of the strict scrutiny, a wide variety of reforms aimed at the second (risk management) and third (internal audit) line of defense ensued globally. These reforms involved a variety of actors and not only affected the institution of risk management and internal audit standards, but also their implementation in banks. Motivated by these contemporary events, this thesis examines the institution and implementation of the second and third line of defense in the banking sector.

Through the three exploratory field studies, the thesis posits two important contributions. First, the thesis highlights the changing notions of risk measurement and internal audit in the banking sector. More specifically, the thesis (in Paper II) shows how non-convergence of operational risk practices forced regulators to change their activity and detail oriented advanced approach of risk measurement that (unintentionally) allowed the variation to flourish. In a similar

vein, the thesis (in Paper III) demonstrates how the extension of internal audit to the non-tangible domain of “risk culture” raises doubts on the notion of “verification” and “control” attached to the practices of internal audit. Second, the findings indicate the different participation approaches of various stakeholders in the transformation of the second and third line of defense. Here, the thesis (in Paper I) demonstrates the separation and mixing of technical information and political rhetoric by the different stakeholders in instituting the liquidity risk standards. On the issue of internal audit of the Basel risk models (in Paper IV), the thesis demonstrates the filtering approaches of multiple institutional demands by the internal organizational conditions that enable full or partial agency of low-level internal auditors.

Given the findings, the thesis explicates two important implications for practitioners. First, the findings of the thesis indicate that reformulations of risk management and internal audit would require standard setters, regulators, and practitioners in understanding a balance between what to control and whom to empower. Second, organizations

need to carefully design what level of freedom to be given to internal audit and risk control teams and how to manage complex institutional demands through organizational structure and skilling initiatives.

A DECISION-MAKING FRAMEWORK TO JOINTLY SUPPORT THE DESIGN AND CONTROL OF SPARE PARTS SUPPLY CHAIN NETWORK: THEORY, MATHEMATICAL MODELS AND APPLICATION

Francisco Javier Tapia Ubeda

Supervisors: Proff. Marco Macchi, Pablo Miranda (PUCV)

Spare parts are key assets for the continuity of process operations in industrial plants, while the spare parts management is a relevant challenge with important cost and performance implications for companies. Companies manage spare parts to reduce the consequences of equipment downtimes and, while doing it, spare part-related decisions may provide relevant means to reduce equipment downtimes with cost-effectiveness. Decision-making approaches are considered to this end. A major background behind them – therefore, behind the models, techniques or criteria developed so far – is that most of the spare parts differ from other typical materials and products due to their specific characteristics and behaviors and, therefore, specific management practices are required. In order to address the specific requirements, different approaches have been developed. Indeed, most of the authors have focused their work on studying, understanding and solving specific problems concerning the spare parts management. Consequently, a relevant number of papers is available for each specific spare parts-related problem, such as – among the most discussed – the forecasting of spare parts demand, spare parts classification, spare

parts inventory management. Nevertheless, there is a lack of more holistic and multidisciplinary approaches to manage the spare parts management in its entirety. Naturally, more integrated approaches may lead to better global solutions. Additionally, it is worth remarking that some relevant spare parts management decisions have been excluded by most of the related literature, among these commonly excluded decisions, the underlying supply chain network, and the related design and control decisions, have been considered only by a scarce number of authors. The integration of these other decisions into the “traditional” spare parts management scope requires the identification of relationships among the different involved decisions. Therefore, a decision-making framework is proposed in order to support the design and control of the spare parts supply chain network. The proposed framework is intended for guiding and supporting the decision-making process in industrial settings. Within it, mathematical models are considered in order to quantitatively support the decision-making process. An industrial case of application of the framework is then adopted,

as a collaborative research carried out with a company in the process industry, and the results are shown within different application settings for decision-making.

Thesis objective:

The main objective of this thesis is the development of an integrated methodology – more in general, framework – for the design and control of the SP-SCN. This framework is based on the relationships between a set of decisions “traditionally” comprised by the SPM and a set of SCN design and control decisions. Moreover, the integrated approach relies on a set of optimization models that integrate SCN design and inventory control decisions. It is worth remarking that, due to the mathematical complexity of the optimization models, it is required to develop solution approaches to find the optimal SCN configuration. Thus, this thesis also considers this computational challenge. The goal of the thesis is not only to develop the integrated approach, it is also to demonstrate its validity in industrial settings. Therefore, to test the proposed integrated approach, a real-world industrial case is considered. Therein, an industrial application is approached as a collaborative research carried out with the

company. The expected results are related to the practical adoption of the decision-making framework within different application settings for decision making.

Research Outcomes:

This thesis considers the development of three papers focused on different but related aspects.

The first paper is entitled “A Decision-Making Framework to Design and Manage the Spare Parts Supply Chain Network” and it is focused on the development of a decision-making framework to support the design and control of the SP-SCN. It is expected that this paper is going to be submitted (during next weeks) in an international journal focused on operations management. This paper identifies a set of key SP-related decisions and the relationships among them. Moreover, the decision-making framework relies on a set of optimization models and solution approaches to support the decision-making process. Consequently, different configurations settings for the SCN are considered and evaluated into the optimization models. Additionally, this paper includes a real-world case of application in an equipment-intensive company. The second paper is titled “An Inventory-Location Modeling Structure for Spare Parts Supply Chain Network Design Problems in Industrial End-User Sites” and it is mainly focused on presenting a generic modeling structure for SP-SCN design. This paper analyzes the relevance of integrating SP-SCN design issues within the traditional SPM, based

on proposing specific network optimization models. Specifically, this paper proposes a generic simultaneous warehouse location and inventory control model structure to optimize the SPSCN. The generic model is specified for three ICPs that are suitable for a great variety of SPs, showing a great potentiality to improve the performance associated to traditional SPM literature. This paper was presented in the context of an international conference within the IFAC, a well-known technical and scientific community. The conference was the recent 16th IFAC Symposium on Information Control Problems in Manufacturing (INCOM 2018), held during June 2018, where the general theme was “Information Control for Responsive Manufacturing Systems”. Additionally, this paper was recently selected to submit an extended version to the International Journal of Productions Research. This extended version was recently submitted, and it is under the first round of review. The current version of the paper is published on IFAC-PapersOnLine, 51(11), 2018, 968-973.

The third paper is titled “A Generalized Benders Decomposition Based Algorithm for an Inventory Location Problem with Stochastic Inventory Capacity Constraints” and it is mainly focused on the development of a solution algorithm based on the Generalized Benders Decomposition (GBD) to solve an ILP model. This paper is particularly relevant because enables to ensure optimality for

the all the tested instances, even considering the mathematical complexity of the model. Mainly based on the novelty of the solution approach developed, this paper represents a clear contribution for academics considering the current state of the art of the related literature. From the practitioners’ perspective, this paper represents a consistent and powerful tool to solve optimization models related to the SCN design and the inventory control. This solution algorithm can be applied in different environments with a similar structure to the ILP model considered in the paper. This paper was accepted and published on the European Journal of Operational Research, 267(3), 2018, 806-817.

BEYONDMATCHMAKING: VALUE CREATION AND CAPTURE IN DIGITALTWO-SIDED PLATFORMS

Daniel Trabucchi - Supervisor: Prof. Tommaso Buganza

Two-sided platforms have become one of the most successful business configurations of the last two decades. Services such as Google, Airbnb, PayPal, eBay, and many more are based on platforms that let two or more groups of participants have some kind of interaction. Not surprisingly, this phenomenon has encountered increasing academic scrutiny: first, in economic literature, and subsequently, in management literature.

Two main categories of Two-Sided Platforms have been described in the literature: transaction Two-Sided Platforms (the platform provider enables a direct transaction between the two sides, such as the end users and merchants for MasterCard), and non-transaction Two-Sided Platforms (such as in the case of newspapers and advertising based media). The two structures are graphically represented in Figure 1.

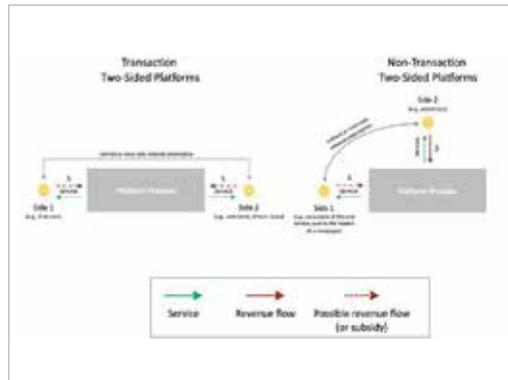


Fig. 1 - Transaction and Non Transaction Two-Sided Platforms

The vast majority of previous studies focuses on one of the key features of this Business Model: the Match-Making process. These companies aim to match different groups of customers, such as travelers searching for a place to stay and hosts offering an empty room. This research aims to go beyond the

matchmaking process, willing to overcome the role of intermediaries between groups of customers to deepen in the peculiarities of these firms. Indeed, these businesses present intrinsic differences when compared to traditional businesses based on a linear value chain. Indeed, recent contributions pointed out how two-sided platforms represent novel kinds of resource configuration that challenges the traditional value dynamics. First, the value is created matching different kinds of customers, instead of working within the firm to directly propose something to the market. Second, the value that can be captured depends directly on the customers' participation due to the effect of network externalities, and not only on the firm's work. Furthermore, the chance to have two different groups of customers enable peculiar kinds of value capturing, for example capturing the value created for the first side (e.g., readers) through another side (e.g., advertisers). Given the novelty of the resource configuration that lies at the basis of Two-Sided Platforms, this thesis aims to dig in the ways in which these companies can create and capture value. Therefore, the main research question is: *how can companies create and capture value through Two-Sided Platforms?*

Value creation is considered as the mechanisms through which a service acquires value that can be captured and shared with the parties involved. Value capturing refers to the ability of a firm to benefit from the value created, which is particularly interesting in a setting where different kinds of customers play a concurrent role in creating value and where the platform may decide to subsidize one or more sides. The overarching goal is divided into sub-questions that explore value dynamics both in terms of creation and capturing. The sub-questions are explored through five different papers that represent sequential steps to reach the thesis goal. The research is based on an inductive qualitative approach, using the smartphone

application industry as the unique empirical setting for the entire study. The thesis contributes to Two-Sided Platforms literature by better defining the boundaries and the differences between Transactional and Non-Transactional models in terms of Business Model Design. Furthermore, it enlarges the traditional view on Two-Sided Platforms suggesting "quality" of the players – instead of only "quantity" – as a driver to enhance cross-side network externalities. In the end, this work introduces the concepts of Client-as-a-target and Client-As-a-source, both in Transactional and Non-Transactional models.

Looking at the other literature streams, this thesis highlights the specific drivers of value creation in Two-Sided Platforms, studying them not as design themes, but as self-reinforcing drivers. Furthermore, it enlarges the network orchestration view taking the specific case of Two-Sided Platforms. In terms of value capturing, it digs in the subsidizing mechanisms at the basis of the chance to offer free or almost free digital services, taking Big Data and related opportunities in the discussion and defining the Client-as-a-Target and Client-As-a-Source strategies. From a practitioner perspective, this thesis provides guidance and support to managers and entrepreneurs dealing with the opportunities and challenges related to the creation, the management, the development or the growth of a Two-Sided Platform (the main models are summarized in Figure 2).

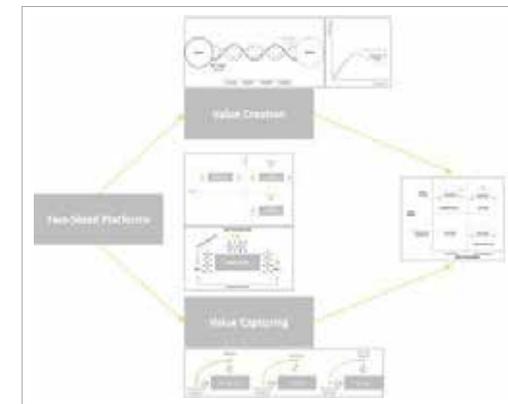


Fig. 2 - Models presented in the thesis

In particular this work may help entrepreneurs and managers dealing with Two-Sided Platforms in three different ways: i) presenting them the different

kinds of Two-Sided Platform, their opportunities and their challenges, ii) supporting them in giving birth to Two-Sided Platforms, offering insights on the peculiarities of the value proposition design of these businesses, and iii) showing different paths to let evolve a Two-Sided Platform in a Hybrid Multi-Sided Platform. In terms of value proposition design, the role of matchmaking has been highlighted, pointing out in particular the four drivers that can make the relationship between the two sides meaningful and viable. Still regarding the ways in which managers can create Two-Sided Platforms, the role of quality in enhancing cross-side network externalities has been pointed out, presenting the chance to rely on "quality-by-choice" and "quality-by-design" tactics. In the end, different alternatives to create an orthogonal Two-Sided Platform (Enhanced advertising, e-Ethnography and Data Trading) have been described. Finally, different strategies (Supply-Side Extension, Transactional Advertising and Data Trading) have been described and analyzed to help managers in creating and capturing value moving from a Two to a Multi Sided Platform.

CONVENING THE GREEN TO HUMANITARIAN LOGISTICS SCENE: A COLLABORATIVE RESEARCH APPROACH FOR EMBEDDING ENVIRONMENTAL SUSTAINABILITY IN HUMANITARIAN LOGISTICS

Mohammad Hossein Zarei - Supervisor: Stefano Ronchi

Background: Humanitarian supply chains are more expanded and global than ever before. Humanitarian organizations, alongside their development counterparts, work around the clock to satisfy the needs of beneficiaries, whether it is an armed conflict in the Middle East, a refugee crisis in Europe, or an ongoing drought in Africa. Meeting the ever-growing humanitarian needs entails intense logistics operations from procurement, to transportation, warehousing, last-mile distribution, and reverse logistics. These operations, despite their undeniable social importance, contribute to considerable adverse environmental impact. However, environmental sustainability has been largely overlooked in humanitarian logistics research hitherto. The objective of this thesis is integrating humanitarian logistics with green supply chain management, two streams within the supply chain management literature which have been growing in isolation from one another.

Theoretical Underpinnings: It builds upon a contingency theory perspective to distinguish the peculiarities of humanitarian environment both at organizational (internal) and contextual (external) levels as

independent variables, while adoption, customization, and development of green practices are the response variables. Through the contingency theory lens, the thesis unearths the organizational and contextual contingent factors that enable or hinder greening humanitarian supply chains. Moreover, it investigates how humanitarian organizations cope with such contingent factors through adopting or customizing extant green practices from the field of green logistics and supply chain management or developing new green practices specific to humanitarian logistics context.

Methodology: An action research methodology was conducted in collaboration with two international humanitarian organizations to integrate environmental sustainability into their supply chains. The researchers (including the author) and practitioners from the humanitarian organizations collaborated for the co-generation of *actionable knowledge*; a type of knowledge generated in mode 2 research which addresses the double hurdle of delivering practitioner relevance and scholarly excellence simultaneously. The collaboration was conducted on cyclic basis where each cycle included design,

data collection, practitioner orientation, collaborative data analysis, collaborative action planning, and implementation.

Theoretical Contributions: The research identifies the contingent factors that impact on greening humanitarian supply chains vis-à-vis intra-organizational management, funding environment, and stakeholders (e.g. suppliers, other humanitarian organizations, country offices and delegations). Next, it explores the mechanisms through which humanitarian organizations can cope with the identified contingent factors. These mechanisms include: i) improving the visibility of headquarters over delegations' operations through increased presence of staff and employing information and communication technologies (ICT) to track products until last-mile distribution and reaching beneficiaries, ii) developing instructions to minimize scavenging during reverse logistics and disposal, iii) promoting cooperation among different implementing partners at each country, and iv) raising flexible funding and donors' awareness about sustainability, inter alia.

Practical Contributions: Owing to the application of action research, the thesis provides strong practical contributions. First, it proposes a

greening framework that frames the extant green practices from the literature in a suitable form for humanitarian organizations. Second, through implementation of action steps in humanitarian supply chains and investigating the success or failure of each step, it offers the lessons learnt to humanitarian practitioners interested in environmental sustainability.

Methodological Contributions: The application of action research in supply chain management, in general, and humanitarian logistics, in specific, is limited. This research contributes to the development of action research methodology in humanitarian logistics research by proposing and implementing an action research framework tailored for humanitarian logistics. It also sheds light on the challenges and opportunities of conducting action research in humanitarian logistics arena.