

MECHANICAL ENGINEERING | PHYSICS |
PRESERVATION OF THE ARCHITECTURAL
HERITAGE | STRUCTURAL, SEISMIC
AND GEOTECHNICAL ENGINEERING |
URBAN PLANNING, DESIGN AND
POLICY | AEROSPACE ENGINEERING |
ARCHITECTURE, BUILT ENVIRONMENT
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ARCHITECTURAL, URBAN AND INTERIOR
DESIGN | BIOENGINEERING | DATA ANALYTICS
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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



Dean:

Prof. Michela Arnaboldi

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 Huisingh, 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 Literature Review.
- 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 Ph.D. 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. Ph.D. s 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 Ph.D. level:

- Double Degree Programme with the Pontificia Universidad Católica de Valparaíso (Chile), Escuela de Ingeniería Industrial, Doctorado en Ingeniería Industrial.
- Double Degree Programme with the Copenhagen Business School (CBS, Denmark), PhD School in Economics and Management.
- Double Degree Programme with the University of Reading, Henley Business School
- (United Kingdom), PhD in Management.
- Double Degree Programme with the National Research University Higher School of Economics in Moscow (Russia).
- Double Degree Programme with TuDelft (The Netherlands).

- Double Degree Programme with Universidad Politécnica de Madrid – UPM (Spain)

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 Scencies, 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.

ASSESSING THE ADOPTION OF INDUSTRIAL ENERGY EFFICIENCY MEASURES - A STUDY TO FOSTER THE ADOPTION OF INDUSTRIAL ENERGY EFFICIENCY MEASURES THROUGH THEIR HOLISTIC ASSESSMENT FROM THE PERSPECTIVE OF THE INDUSTRIAL DECISION-MAKER

Davide Accordini - Supervisor: Prof. Enrico Cagno

Research background

Industrial energy efficiency is globally recognized as an element of utmost importance in the struggle for the sector's consumption reduction, sustainability and decarbonization. Nevertheless, the adoption rate of interventions aiming at improving its levels, namely energy efficiency measures, is still low compared to the potential target, leading to the phenomenon known as the energy efficiency gap. Years of academic research widely proved how the adoption of industrial energy efficiency measures could actually represent a profitable investment for companies, effectively discrediting the initial neo-classical formulations based on the lack of cost-effectiveness to prompt the adoption [42]. Interestingly, however, even energy efficiency measures seemingly highly profitable in the eyes of the energy auditors who suggested their implementation, suffer from a low adoption rate [21], highlighting how profitability, although relevant from a business decision-making perspective, cannot be the only barrier preventing a high adoption rate. Past literature identified in fact how barriers of other natures exist, e.g., competition for internal

resources or organizational barriers, with the lion's share played by barriers related to the lack of information over the adoption of energy efficiency measures. In fact, key factors other than the techno-economic ones might play a role in decision-making - acting as barriers or enablers for the adoption -, and the lack of comprehension of these factors could represent in itself a strong barrier hindering the energy efficiency of the industry. Further supporting this analysis is the fact that heterogeneous energy efficiency measures, differing in terms of factors other than profitability, are implemented at different rates in the industry, but also that the same energy efficiency measure is adopted differently by varying, e.g., the sector or size of companies. Nonetheless, these factors, their interrelationships and their influence on adopting an energy efficiency measure have been scarcely assessed in the literature and an exhaustive analysis is still lacking.

Research objective

Building on this literature gap, the objective of the thesis - which consists of a collection of five papers - is to foster the energy efficiency of an industrial manufacturing company by

providing decision-makers with the required knowledge to holistically assess the adoption of an energy efficiency measure. The suggested assessment approach should go beyond a simple techno-economic analysis covering all the key factors that might affect the decision-making outcome, from the technical ones to the operational-related ones. In particular, the assessment is developed along three main dimensions of analysis: (i) factors referring to the characterization of energy efficiency measures (namely energy efficiency measures characteristics), to discriminate the heterogeneous sample of industrial energy efficiency measures according to key criteria; (ii) the impacts on a company's resources generated by the efficiency investments once installed in an industrial plant (e.g., improved productivity, company image, etc.) and a set of metrics, to effectively allow for their consideration in decision-making. In addition, (iii) light is shed on the third dimension of analysis, i.e., the context of adoption, which might strongly affect the decision-making outcome by influencing both the energy efficiency measures characteristics and their multiple impacts.

Research methods

To conduct the research, the following research methods have been used: literature review, multiple case studies, performed through semi-structured interviews during field visits, and a survey, conducted through structured telephone interviews. While the literature reviews enabled the theoretical development of the frameworks, the empirical methods allowed for their validation and application on field.

Research results and contributions

Results show how all three dimensions of analysis should be factored in for sound decision-making over the adoption of an industrial energy efficiency measure, also considering the mutual relationships they conceive. The energy efficiency measure characteristics help to discriminate the heterogeneous sample of industrial energy efficiency measures according to key criteria, revealing how investments targeting, e.g., different technologies, conceal different implications in terms of, e.g., complexity and knowledge to carry out the implementation or even motivations driving the underlying adopting companies, ranging from operative to

strategic reasons. Especially for those technologies acting on the core process of a company, the non-energy motivations seem to represent very often the true lever to foster the implementation rate of industrial energy efficiency measures, shedding light on the necessity to adopt a more holistic approach to assess their adoption. Moreover, even the same investment can be perceived differently changing the context in which the adoption takes place, requiring the assessment to be properly contextualized to the specific application and company background.

The research contributes to the academic discussion about energy efficiency measures and their low adoption rate, providing a different lens through which to observe and explain the phenomenon of the energy efficiency gap. Furthermore, the new and holistic assessment approach suggested in the thesis could represent a valid support for company managers and owners, i.e., industrial decision-makers, particularly required in the case of small and medium manufacturing enterprises, despite the thesis does not target a specific company size. Providing more transparency to the adoption

process, the research could also strengthen the relationships between the heterogeneous stakeholders partaking in the energy efficiency supply chain (e.g., service and technology providers, industry associations, and financial institutions), better supporting the adoption of EEMs. Policymakers could eventually grasp interesting insights for designing more efficient and effective policies directed toward improving industrial energy efficiency.

THE IMPACT OF WORKPLACE FLEXIBILITY ON THE WELLBEING OF EMPLOYEES: A FOCUS ON WORK ENGAGEMENT

Gabriele Boccoli – Supervisor: Prof. Luca Gastaldi

Technology development and Covid19 pandemic have increased organizations' adoption of flexible work practices. Workplace flexibility leads individuals to experience different social roles (e.g. familiar roles and job roles) within the same physical environment time. In this new scenario, in which individuals keep constantly entering and quitting from one role to another one, it could be difficult to manage different social roles and remain attached to them. In this sense, work engagement, considered as the attachment towards the own job role and a measurement of the wellbeing of employees, may be deeply affected by this changed situation. Previous studies focused on the relationship between flexibility and the wellbeing of employees have shown contradictory results, highlighting the so-called "autonomy paradox". This thesis, articulated as a collection of five papers (4 empirical studies and 1 literature review), has two main research objectives. First, understanding how work engagement and wellbeing of employees are influenced by flexible work practices in increasingly digital environments. Second, investigate the social and

relational nature of engagement with a more sociological perspective and how it could be connected to the phenomenon of workplace flexibility. Specifically, this thesis intends:

- to understand which flexible practices may influence positively the wellbeing and the work engagement within a forced remote working context. The choice to analyse this kind of relationship within this specific context (in which we were forced to work from home) was since this thesis started to be developed during the pandemic;
- to investigate how workplace flexibility may impact the wellbeing of employees, considering flexibility also as a psychological process. After this initial period, forced remote working has finished being forced and many work organizations have decided to guarantee flexible practices. Past studies demonstrated contradictory results regarding the impact of flexibility on the wellbeing of employees, leading us to the phenomenon so-called autonomy paradox;
- to analyse how remote working has changed the relationship between supervisor and their collaborators, and consequently the wellbeing of employees.

Previous studies have demonstrated contradictory results on the impact of remote working on the quality of this relationship. For this reason, it could be helpful to try to investigate which factors may favor a positive relationship between them and the possibility to exhibit a leadership approach effectively even when supervisors and their collaborators work from different locations.

- to investigate whether digital communication channels used within remote working contexts (thus characterized by the adoption of flexible practices) to communicate and collaborate by workers may offer new solutions to measure the work engagement of employees embracing new perspectives as well.

The studies presented within this thesis have been developed within a Joint Research Centre (JRC) through the collaboration between the department of Management Engineering the department of Electronics, Information, and Bio-engineering, and different companies such as Mediolanum Bank, Credem, A2A Life Company, Poste Italiane, Costa Crociere and Maire Technimont and Microsoft. The JRC aims at investigating

which kind of factors might impact on work engagement of employees in different empirical contexts, using different data coming from both surveys and information systems. Furthermore, it has been investigated the impact of remote work, characterized by spatial and temporal flexibility, on work engagement wellbeing, and performances of employees. Empirical studies have been developed through a collaborative and quantitative, and longitudinal approach through the design and distribution of the survey, allowing us to test hypotheses and the relationship among the variables identified. The literature review has been developed with a semi-systematic approach. Results demonstrate the importance of controlling social boundaries when individuals experience flexibility. Findings, in fact, demonstrate that employees with high levels of psychological job control and boundary control influence present the highest values of wellbeing in terms of job satisfaction and work-life balance. In contrast, individuals with low levels of psychological job control and boundary control present the lowest values. Considering work engagement, results demonstrate that the highest values of it are represented by flexible workers with high levels of psychological job control and low levels of boundary control. This finding suggests that when employees have less control over their social boundaries, they may have more difficulty to detach themselves from their job

roles, thus resulting to be more engaged. This evidence may offer a possible further explanation regarding the phenomenon of autonomy paradox. Results demonstrated also that temporal flexibility jointly with job autonomy positively influences the psychological wellbeing of employees, through a good balance of work and personal life. Analysing the relationship between supervisors and their collaborators, one of the most important factors able to influence the degree of work engagement of individuals, this thesis shows that a high frequency of interaction between them can help in maintaining social cohesion within the teams who work from separate locations, influencing the degree of engagement and positive behaviours of individuals. Additionally, transformational leaders, may be more effective working remotely, mainly exhibiting to have the digital communication skills to handle virtual interactions. Finally, workplace flexibility is supported by the use of digital technologies which allow workers to communicate and collaborate remotely. The adoption of specific digital platform (such as MTeams, Zoom, etc.) and the use of different communication channels generate a remarkable amount of data. These collaborative data may represent an occasion to measure and investigate work engagement more dynamically through different methodological and theoretical perspectives. For instance, by analysing the

social network of flexible workers and combining these data with the ones gathered through the survey, it could be possible analyse work engagement more dynamically and with a more sociological lens. In this sense, results highlight three main social conditions able to define work engagement, which are respectively social interaction, social exchange, and social recognition. Starting from these conditions, more attention to social capital should be provided promoting a paradigmatical shift from human resource management to a social resource management perspective. Finally, from a practitioner's viewpoint, this thesis might provide relevant indications to organizations and managers on how they may measure, stimulate and nurture the work engagement and the wellbeing of employees within a context characterized by high flexibility. In addition, this thesis will provide some guidelines to managers on how they can adopt suitable leadership approaches and handle their relationships with their collaborators.

THE PARADOXICAL RELATIONSHIP BETWEEN ART AND MANAGEMENT: CORPORATE COLLECTIONS FOR ORGANIZATION'S VALUE CREATION

Eleonora Carloni – Supervisor: Prof. Michela Arnaboldi

Increasing numbers of organizations are blurring their boundaries with art in search of novel perspectives for competitive and social challenges. Equally policymakers are conceiving programs to boost industry-art collaboration for sustainable development, recognizing culture as the fourth pillar of corporate sustainability.

A non-arts organization (i.e., an organization not naturally devoted to arts and cultural heritage and run by Management principles) might embed Art in numerous ways: by directly employing artists, by creating a residency for artists in house, by investing on a corporate collection, and by founding their corporate museum. The embeddedness of art within a non-arts organization might be dictated by disparate purposes, but all oriented to organization's value creation. Just to mention a few: to foster employees' creativity and to inspire new meanings in innovation, to empower employees' knowledge, to improve corporate reputation through philanthropic initiatives, and to improve brand authenticity to the eyes of customers and the broader stakeholders.

However, the daily co-existence of Art and Management within the same organizational boundaries can be complex, and sometimes implausible, due to their innately different natures. Art and Management have been indeed ascribed for ages as competing forces. They have diverse principles (e.g., gratuity versus utility), diverse processes (e.g., standardized versus unique), diverse tools (e.g., pure artifacts versus raw materials), and diverse languages (e.g., experiences versus numbers). On top, although being different, the two opposites are supposed to collaborate for the organizational creation of value, but the Art's orientation towards the utility-oriented Management world seems controversial. Despite of the acknowledgement of an underlying complexity, scholars have avoided to enter in the micro-dynamics of art's embeddedness in the non-arts organization, which might reveal contradictions between the two sides on a more operative base. Further, previous studies have considered frictions only in a positive way as the occasion for an Art's take-over on Management, and with limits to sporadic and temporary collaborations with artists. At the same time, preceding

contributions, and practitioners' testimonies, argue a certain failure rate of more enduring initiatives, where the Art and Management relationship is more prolonged.

Notwithstanding this, the founding hypothesis of the Doctoral Thesis is that Art and Management relationship is undeniably favorable but complex to govern, and that this complexity can lead to the failure of such strategic initiatives. Therefore, with attention to corporate collections as embedded and enduring arts-based initiatives, the Thesis investigates potential operational frictions that could jeopardize the scale-up of the initiative and its synergic role to the organization's value creation.

More specifically, the complex relationship between Art and Management is framed as paradoxical, being paradox seminally defined as when contradictory but interrelated elements exist and persist simultaneously over time and in the same context. In the light of this framing, the Doctoral Thesis aims to explore rather than suppress the paradoxical contradictions and tensions stemming from Art

and Management duality, with reference to three operational micro-dynamics that previous studies have highlighted as particularly complex. To do so, the Doctoral Thesis is configured as a collection of three papers, with each paper addressing a specific micro-dynamic, as in the conceptual framework.

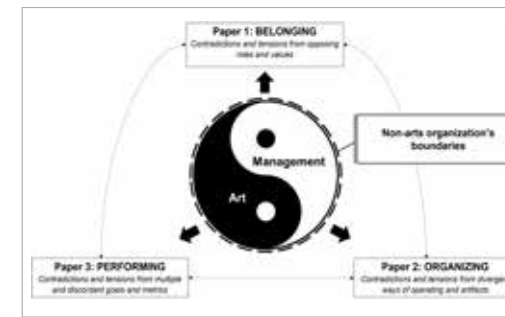


Fig. 1 – Conceptual Framework of the Thesis, adapted from Smith & Lewis (2011)

The first study investigates the complex micro-dynamic of combining people, with diverse backgrounds (e.g., artists and managers), within the same space, which could lead to contradictions and tensions in terms of roles and values, such as uncertainty about true belonging to the collective organization. This first belonging micro-dynamic is explored by the Research Question: "How does art become integrated into a non-arts organization over time?".

The second paper delves into the tough micro-dynamic of organizing the collaboration between the two sides on a certain process of value for the organization, which could lead to contradictions and tensions in terms of divergent ways of operating and artifacts. This second organizing micro-dynamic is explored by the Research Question: "How can art support the core processes of the non-arts organization?".

The third manuscript focuses on the tricky micro-dynamic of setting goals and measurement indicators to assess Art's performance towards the non-arts organization, which might lead to contradictions and tensions, such as uncertainty on Art's expected output or hesitation on using numerical indicators. This third performing

micro-dynamic refers to the Research Question 3: "How is a Performance Measurement System designed to measure art's performance towards the non-arts organization?".

Empirically, all the three studies are based on Italian organizations with corporate collections (of both artistic and historical artifacts), as exemplary form of embedded arts-based initiatives from a particularly vivid country for artistic interventions. At the methodological level, the research is addressed with in-depth qualitative methodology, with tools ranging between case-study to participant research, relying on a great number of varied data sources and rigorous data analysis.

Taking a social constructivist perspective, the Doctoral Thesis makes sense of how actors directly deal with the contradictions and tensions emerging in the three complex micro-dynamics of embedding art into a non-arts organization for its value creation. In this way, the Doctoral Thesis theoretically speculates on the unavoidable paradoxical relationship between Art and Management, and it evidences how the duality is never solved but transformed. Art is purposely allowed to preserve its sense of self in the daily, but with the acceptance of serving non-arts organization's value creation, and under long-term oriented strategic directions from the Management. In this interplay between Art's operational autonomy and Management's strategic guidelines, the two sides create a ruled duality to the advantage of the non-arts organization's value creation, but they preserve the paradoxical nature of Art and Management relationship.

RESHORING POTENTIAL INDEX (RPI) – ASSESSING THE RESHORABILITY OF ITALIAN COMPANIES LOCATED ABROAD: A METHODOLOGY AND ITS APPLICATION OVER A SAMPLE OF COMPANIES FROM THE EMILIA-ROMAGNA REGION

Luis Augusto de Freitas Cordeiro

Supervisors: Prof. Stefano Elia, Prof. Paolo Barbieri

The project is structured to answer a question of whether it is possible to develop a sufficiently accurate methodology to assess the reshoring of companies' foreign subsidiaries, i.e. a method capable of evaluating how favourable or unfavourable one unit located abroad is to being relocated to another territory, encompassing several relevant elements (micro- and macro-aspects) that are put together and balanced according to their pertinence, delivering a final outcome as a ranking score that indicates the trend of each single unit analysed regarding their potential of reshoring, which is a very important factor due to the potential benefits that such strategies can generate in the regions that absorb such activities, i.e. return of investments, development or enhancement of local technological capabilities and infrastructure, increase of tax revenue and wealth generation, growth of job offers, reduction of unemployment rates, strengthening of the local economy, and increasing general social welfare. Therefore, these indexes have an intrinsic power to guide and support future governmental and private businesses actions that can

promotes an increase of social and business welfare in the benchmarking regions as well as driving regional technological, infrastructure and economic improvements. The development of this project took into account the only scientific work published up to now that has attempted to establish a reshoring potential index (RPI) – the conference paper from Sarder and Nakka (2014), which addressed this issue by embracing in its structure 7 macro-aspects to calculate it. This research, differently from the work mentioned, has deepened and broadened the spectrum of analysis encompassing several micro- and macro-aspects, evaluating the reshoring of both manufacturing and service companies that have settled their facilities abroad by in- or out-sourcing governance mode, providing the flexibility to analyse all types of reshoring (back-, near- and further-off-shoring), according to Fratocchi et al. (2014), and evaluating the reshoring of entire industrial segments, corporations or single units. The thesis is organized as follows: the first part consists of an introductory chapter, followed by a second part that

presents the systematic literature review (SLR) undertaken, which identified 336 pertinent documents from which were extracted 165 motives that exert influence on the reshoring of company subsidiaries, that later were allocated among the 13 main research fields that have investigated the reshoring phenomenon up to now. The third part comprises the analysis and subsequent conversion of these motives into measurable metrics resulting in the establishment of 31 RPI indicators, 11 associated to internal factors and 20 to external ones, that are incorporated in the RPI equations that uses the Multi-Attribute Value Theory (MAVT) to gauged units' reshoring. The fourth section embraces the quantitative results obtained from the RPI method developed by this thesis, testing its robustness and validating its outcomes through a cross-check validation process made to compare RPI's ranking scores with the output gathered from 8 high-level interviews done with managers from the enterprises embraced by the sample population tested by this method. The sample tested used to run and test the RPI methodology consisted of 312 companies with 928 foreign units present in 94 countries,

operating in 45 different sectors of activities according to REPRINT's classification or 33 sectors according to the ATECO 2007 - NACE 2 codes (taking as reference only the first two numbers of its codification), where 459 of these international units consisting of big companies (MNEs), since they have more than 250 registered employees, and 469 consisting of medium-small companies (SMEs), since they have less than 250 collaborators. Figure.1 shows the final scores calculated for RPI_{Total} which are put together (summing and balancing) both values of $RPI_{Internal}$ and $RPI_{External}$ presenting the reshoring of all 928 units evaluated according to their reshoring score spread in a curve shape to permit a better understanding of its dispersion, also showing the correlated values of both $RPI_{Internal}$ and $RPI_{External}$.

Evaluating the attained results, it is possible to identify that there are 50 units within the range of mid-high potential of reshoring, representing 5.39%

of the total sample population, 33 subsidiaries are in the mid-low range, which represent 3.56% of the sample, and all other 845 (91.06%) are neutral to reshoring strategies, and no units with very-high, high, low or very-low reshoring potential. Considering the characteristics extracted from the group of 50 units within the range of mid-high potential of reshoring, it was possible to draw a main profile of the companies with higher potential for re-entry in Italy, which is: 'SME that was created by an entry mode of Acquisition, Merge or Joint-Venture', is 100% owned by the Italian headquarters, suffered a significant reduction in its revenues (sales) and personnel, operating for more than 7 years, belonging to industrial segments that have a medium to high intensity of technology in its products or processes, located in countries whose inflation, annual wages averages and costs with intellectual property charges increased significantly. Where local investments in research and development have been reduced, the unions got stronger and where

unemployment rates decreased'. Therefore, based on the results widely discussed throughout the thesis, it is possible to state that this project achieved its goal, i.e. it was possible to develop an RPI methodology capable of assessing firms' subsidiary reshoring potential with acceptable accuracy. Furthermore, it is possible to state that in addition to the above advantages provided by this methodology, it can also support other scholars to better delineate the borders of their projects or scope of research, it can provide invaluable input and support for practitioners and managers in future location decisions and investment analysis, and lastly, it can support policy makers and government representatives in developing new policies capable of attracting new investments and by consequence, promoting an increase in their territories' social and business welfare.

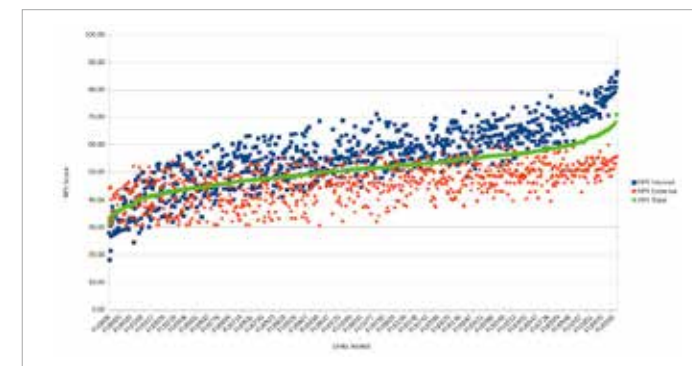


Fig. 1 - RPI_{Total} scores presented in a linear dispersion graphic

THE ROLE OF ARTIFICIAL INTELLIGENCE IN THE PROCUREMENT PROCESS

Michela Guida – Supervisor: Prof. Federico Caniato

The central objective of my research is to study the role of Artificial Intelligence (AI) in the procurement process, addressing the overarching research question *"What is the role of Artificial Intelligence in the Procurement process?"*. With the mission to answer this research question, I conducted several studies during my PhD, crafting a collection of four papers.

Paper 1 is the conceptual basis of my thesis and, at the same time, it is the framing of the whole research. Paper 1 presents an exploratory study of the role of AI in the procurement process, aiming at charting the state of the art of research and practice and identifying future research directions. The paper combines a systematic literature review, a mapping of the AI-based procurement solutions offered by IT providers, and a focus group with thirteen procurement managers. The results map the functionalities of AI-based solutions throughout the procurement process (Spina, 2012), describe the benefits and challenges in adopting AI, and identify future research directions at the intersection of AI and procurement. Some of these directions have already been bridged in my Ph.D. thesis: Papers 2, 3 and 4 dig into three procurement activities described

among the future research directions in Paper 1.

Through a multiple actor perspective, Paper 2 studies the adoption of Supply Chain Finance (SCF) to identify the phases of the SCF innovation process impacted by AI. Leveraging ten case studies of SCF providers, the activities impacted by AI are classified along with the phases and sub-phases of the SCF innovation process (Rogers, 2003; Wuttke et al., 2013), and benefits and challenges are identified for buyers, suppliers, and SCF providers.

Papers 3 and 4 adopt the same theoretical lens, i.e. the Information Processing Theory (IPT). Paper 3 investigates the impact of AI on the spend classification performed by a buyer firm, identifying the information processing needs and capabilities underlying the adoption of AI in spend classification. The case study methodology involves the IT providers currently offering AI-based spend classification solutions as privileged respondents. Information processing needs in spend classification are high for buyer firms. Often, they are not supported by internal information processing capabilities and the AI-based solutions offered by IT providers for spend classification compensate for the lacking

capabilities of the buyer, enabling the fit between information processing needs and capabilities (Tushman and Nadler, 1978).

The research in Paper 4 investigates the role of AI in the supplier scouting activity with a similar approach to Paper 3, as the IPT constitutes the overarching theoretical structure. Twelve case studies of IT- and information-providers offering AI-based scouting solutions were developed. In the buyer firms, information processing needs in supplier scouting are high. IT and information providers can meet the buyers' needs through the information processing capabilities enabled by AI-based solutions. In this way, the fit between needs and capabilities can be reached. Although the papers in this thesis only partially cover the knowledge gap at the intersection between the domain of AI and the procurement discipline, they exert an initial effort in structuring a novel phenomenon. My Ph.D. thesis contributes significantly to the academic field of procurement when it intersects the domain of digital technologies, AI specifically. The four papers in my thesis collection contribute to defining the fundamental building blocks of a novel phenomenon and satisfy the need to develop more empirical studies (Lorentz et al., 2021). The

procurement process (Spina, 2012) has been taken as the overarching model to ensure consistency in the research design and data collection from different sources. The focus of the procurement process is not common in previous studies. Toorajipour et al. (2021) developed a literature review about AI techniques in the crucial processes of supply chain management. However, to my knowledge, a literature review taking the procurement process as the focal point did not exist, and my work is even more valuable when it comes to the novelty brought by AI. This structured approach is fundamental to compiling current knowledge and laying the foundations for the future development of the topic, both within my thesis and outside my studies, such as in the research of other scholars.

My thesis moves towards the humble mission of contributing to unveiling the power of such technological tools since actual results are challenging to assess (Lorentz et al., 2020), and the literature lacks examples of successful implementation in the procurement field. Therefore, case studies are the preferred methodology for investigating the empirical setting (Yin, 2018). In the case studies, the key respondents are IT providers due to their central role in developing and deploying new technologies. However, in each case study, the buyers' perspective is also brought out, as they are the actual users of the AI-based solutions. In this way, the relational dimension between the IT provider and the buyer is further explored, being the

glue for the complete success of digital innovation in procurement (Choonghyun et al., 2011). Finally, my Ph.D. thesis also contributes to strengthening the procurement discipline's theoretical basis. In Paper 2, a structured framework has been developed based on the innovation process framework by Rogers (2003). Starting from the innovation process framework by Rogers (2003), Paper 2 formalizes the key constructs in studying the role of AI in the SCF innovation process. In this way, Paper 2 adds the technological component to the traditional concepts, and confirms the validity of the framework by Rogers (2003), contributing to its further advancement and application in new research fields.

Two papers in my thesis are based on the Information Processing Theory, which was fundamental in providing a grounded structure to the findings. The IPT has been developed over several years through various formulations, additions, and applications in different domains (Duncan, 1972; Galbraith, 1974; Tushman and Nadler, 1978; Bensaou and Venkatraman, 1995). Thus, this thesis demonstrates the applicability of IPT in studying the role of AI in the procurement activities, so contributing to the purchasing domain and the IPT research. This thesis illustrates how the proper information processing capabilities reduce the buyer firm's uncertainty. The information processing capabilities are developed by the IT provider and transferred to the buyer firm in the AI-based

platform, representing a fundamental enabler for the increased competitive advantage of the procurement department. Then, starting from the original intra-firm (Galbraith, 1974) and inter-firm IPT formalizations (Bensaou and Venkatraman, 1995), the case studies reveal how the uncertainty arises within the buyer firm perimeter and how the boundaries are extended thanks to the capabilities of the IT providers, coming to match the high Information Processing Needs in the procurement activities. From a practitioner perspective, my Ph.D. thesis delivers a well-structured contribution. From Paper 1, the buyer firm gains increased awareness about digital procurement: the overview of available AI-based solutions provides real insight into the possibilities for procurement departments. This view is then augmented by identifying benefits and challenges: it gives procurement managers the necessary understanding about the implications of AI in procurement, stimulating interest and knowledge in the phenomenon. Papers 2, 3, and 4 contribute to the managerial perspective through increased focus on specific activities. They take a multi-actor point of view, studying the phenomenon by including all parties involved in the unit of analysis.

Keywords: Procurement, Procurement Process, Artificial Intelligence, Supply Chain Finance, Spend Classification, Supplier Scouting

OUT WITH THE OLD, IN WITH THE NEW: ESSAYS ON MANAGEMENT INNOVATION IN THE DIGITAL ERA

Désirée A. Laubengaier – Supervisor: Prof. Raffaella Cagliano

The world of business and work is transforming profoundly and rapidly. In many ways, it is entirely different than it was just a decade ago. In today's technology-driven world, companies are faced with the need to innovate. The digital era forces companies to rethink their organizations and reinvent themselves.

Historically, new technologies were a powerful lever but nowadays technology is only one part of "the complex puzzle that must be solved for organizations to remain competitive in a digital world" (Vial, 2019, p. 118). That being the case, digital transformation goes beyond technological breakthroughs but comes about with the emergence of novel ways of organizing and managing inside firms.

In the digital era, the pursuit of management innovations plays a significant role. There is widespread belief that it is the type of innovation that contributes the most to a company's competitive advantage. Despite their importance, management innovations represent a complex and challenging endeavor and companies struggle to implement them. Taken together, from a corporate perspective, management innovation is a necessity but at the same time a challenge. A management innovation that attracts

recognition across the corporate landscape as the way of doing business in the digital age is "agile": a set of management practices geared towards adaptability and speed to meet the requirements of our rapidly changing world. As management innovation remains underresearched in many respects. That is, the link between management innovation and technological innovation in the digital age is an open question. Further, the implementation of management innovation is largely unexplored and thus deserves scholarly attention. In addition, as the microfoundations of management innovation are widely neglected, there are knowledge gaps regarding individuals' role. Also, there is a lack of empirical data. In response to these aspects and motivated by the pervasive digital transformation that necessitates organizations to undergo fundamental changes, this dissertation empirically examines the phenomenon of management innovation to understand and explain how these innovations are introduced and broadly entrenched inside an organization. This dissertation aims to address the following research question: *How do companies introduce management innovation inside the organization?*

To explore the within-firm

introduction of new management approaches comprehensively, this dissertation involves different degrees of specificity concerning management innovation. On the one hand, this dissertation considers management innovation in general to gain an understanding of how companies introduce this type of innovation interrelatedly with new technology. On the other hand, this dissertation involves the focus on a specific management innovation that is relevant in the digital age (i.e., agile) to obtain detailed insights into the innovation's implementation inside the organization. This dissertation further approaches management innovation from an organizational and individual perspective. organizational perspective is adopted which helps to develop a multifaceted understanding of how organizations proceed in implementing management innovation by capturing diverse aspects that are associated with the introduction. Second, this dissertation applies an individual perspective to delve into the microfoundations of management innovation. The aim of doing so is to clarify and better understand key organization members' roles in the introduction of management innovation. Bringing together these two different perspectives on the

phenomenon contributes to a more in-depth understanding of how organizations manage the journey and how actors come into play. Tackling the overall research objective, the dissertation comprises three studies. Study I deals with the introduction of technological vis-à-vis organizational renewal in the context of Industry 4.0 and identifies patterns in which companies introduce these innovations. Doing so, Study I conducts a qualitative meta-analysis. The results suggest a complex, multifaceted relationship between management innovation and technological innovation with four ways of interaction being identified. Management innovation can precede technological innovation, and vice versa, indicating their sequential introduction. Further, the two innovation types can be introduced simultaneously, pointing to their co-emergence. Finally, management innovation and technological innovation complement rather than substitute each other.

Study I reveals that strategy, work design, and people management are crucial in terms of Industry 4.0 endeavors.

The findings suggest that companies are required to not only pursue new technologies but to engage in innovating the organizational sphere as well. The complex relationship between the innovation suggests that there is no one-size-fits-all approach or a single best strategy in terms of how firms should combine innovations in the pursuit of Industry 4.0.

Study II empirically examines the implementation of management innovation implementation to unpack the process and shed light on underlying mechanisms and dynamics. The empirical context of management innovation is agile in order to tap into a management innovation of highest relevance in the digital age.

Results of a multiple case study of a multiple-case study suggest that the implementation of management innovation proceeds over four stages: (1) considering innovation, (2) familiarizing, (3) piloting, and (4) expanding. The last two stages, during which the novel practices are put into use, proceed non-linear and are characterized by oscillations. During implementation, manifold changes need to be infused into the organization. Hence, implementation is a period of intra-organizational misalignment with which organization members have to cope. The mechanism underlying implementation is in-vivo experimenting. It is through experimenting with the novel practices that organization members get skillful with them, use, and spread them.

Study III adopts an individual perspective to engage with the microfoundations of management innovation and explore managers' role. The focus is on managers because these are individuals of utmost importance inside an organization as also suggested by upper echelons theory for instance. In the literature, managers are typically depicted as agents rather than recipients of change. The fact that managers themselves can be agents and

recipients requires scholarly attention as it is largely overlooked in theoretical accounts and empirical research. The study relies on insights from interviews conducted with managers. The study reveals that in the realm of management innovation, managers (are expected to) have dual roles: change agent and change recipient. Agile further confronts managers with the requirement to act as 'manager' or 'coach', depending on the situation. Hence, in the case of agile, within the change recipient role resides a further duality such that managers are confronted with a double dual role. Yet, the study finds that many managers face difficulties with their dual roles. They struggle with the changes they have to embrace (recipient role) and their change agent role. The dual roles are a source of tensions with which the individuals have to cope. Based on the findings, the study develops the notion of the management innovation actor: an individual that typically assumes managerial authority and has a dual role of change agent and recipient. As a whole, this dissertation contributes to extant research by approaching management innovation, its relationship to technological innovation, the implementation process, and the microfoundations. In conclusion, this dissertation addresses a leading-edge topic that is at the forefront of business strategy thinking as it deals with the renewal of organizational and managerial aspects in the digital age.

GENDER STEREOTYPES AND GENDER IN SCIENCE

Raffaele Mancuso

Supervisors: Prof. Cristina Rossi Lamastra, Prof. Mara Tanelli

There are various gender gaps in the labour market, which might be due to different causes. In this dissertation we focus on one specific cause: gender stereotypes.

Stereotypes are “generalizations about groups that are applied to individual group members simply because they belong to that group”. Gender stereotypes are “generalizations about the attributes of men and women”.

Gender stereotypes can be descriptive or prescriptive. Descriptive stereotypes designate “what women and men are like”, while prescriptive stereotypes designate “what women and men should be like”.

In particular, according to gender stereotypes, males are characterized as being agentic, while women are characterized as being communal. Agency is characterized by: (1) achievement orientation, (2) inclination to take charge, (3) autonomy and (4) rationality. On the other hand, communality is characterized by: (1) concern for others, (2) affiliative tendencies, (3) deference and (4) emotional sensitivity.

The more accredited theory of gender stereotypes genesis is the

social role theory. The Social Role Theory prescribes that we develop gender stereotypes by observing men and women in social roles. For example, if women are segregated into jobs that require caring, when we observe those workers we develop an association between caring and women. On the other hand, if men are segregated into jobs that require assertiveness, we develop an association between men and assertiveness.

Additional evidence suggest that this work the other way around too: feminine personality traits are thought essential for success in female dominated jobs, while male personality traits are thought essential for success in male dominated jobs. Exposure to stereotypic threat increase support for the status quo of women. It is also interesting how gender stereotypes can be self-reinforcing, as women expected to act as communal and men expected to act as agentic will in fact act accordingly.

Gender stereotypes can generate consequences in behavior during both pre-labor market entry and post-labor market entry. Regarding the former, stereotypes can generate social and psychological barriers for men interested in

entering in communal roles, or may prevent women from using assertiveness in self-advocacy due to fear of backlash. Another consequence may be job-referrals, with women referring other women and men not showing a particular preference, also due to gender stereotypes.

Regarding the consequences of gender stereotypes in post-market entry behavior, it has been posited in the literature, for example, that the paucity of women in the upper echelons of organizations spurs from gender stereotyped evaluations. In fact, gender stereotypes can result in devaluation of the performance of women, not attributing the success they achieve to endogenous factors, but rather to exogenous ones, or even backlash for being competent.

In fact, leadership is portrayed with stereotypical masculine characteristics, characterized by greater agency than communion and greater masculinity than femininity, in what is called the “think manager, think male” stereotype. Women who achieve success are less likely and more derogated than comparable men, but only when the success is in a male-dominated area, and this backlash lead to lower evaluations and lower likelihood to

be recommended for rewards.

In the first paper of the thesis, we offer a comprehensive review of the empirical literature on the consequences of gender stereotypes published between 2011 and 2020. We find 60 relevant papers, and we systematized their findings by grouping them into specific categories that we identified through our own reading. These categories classify papers depending on the hierarchical positions in the organization of the individuals the paper talk about as well as the stage in their careers. Drawing on this structured synthesis of the literature, we explain the role that gender stereotypes play on women's career outcomes, we identify research gaps, and we propose directions for future research.

Gender stereotypes hamper women and girls achievements in the sciences too. For instance, stereotypes may associate high cognitive abilities more with men than with women. These stereotypes are endorsed by girls as young as 6, who comes to believe that girls are not as likely as boys to be “really, really smart”, and influence the decisions and choices of such girls, who avoid activities that are classified for “smart” children.

Another stereotype is that boys are good at math, while girls are good at reading¹. Girls who endorse these stereotype score lower on math tests, and if their elementary school teacher is female, the more their teacher is anxious about math, the more girls, but not boys, come to

endorse this stereotype.

These stereotypes about women and STEM may decrease the likelihood of women to enroll in STEM courses, specially when they perceive multiple signals of unfit. In fact, a large of the gender gap in STEM fields is due to social stereotypes, and to girls perceived fitness in math. A masculine culture that signals lower belonging of women in the fields of physics, computer science and engineering than men, a lack of previous experience with those fields and gender-gaps in self-efficacy all contribute to explain part of the gender gap we observe in STEM.

An important part of the tenure-track position is getting funds for the research, as the achievement of tenure depends on the ability of getting funds and publish. While nowadays the success rate at major research agencies is the same between men and women, the application rate is not, as women apply as a much lower rate than men.

In the second paper of this dissertation, we explore what may be the causes of that. By building on a dataset provided to us by the Swedish Foundation for Strategic Research, we collect bibliometrics information for applicants to 21 calls, both winners and non-winners. Furthermore, we devise a strategy to construct sets of potential applicants on a call-by-call basis, that is, applicants who could have applied to the calls but did not do so, and collect bibliometrics measure on them too.

After confirming from our analysis that women apply at a lower rate than what they are represented in the general population of potential applicants, we study whether the masculine language of the calls determine the lower application rate of women. In fact, job offers that are stereotypically described as masculine may lead to a decrease likelihood of women to apply, as women would perceive themselves as unfit for the job. By then measuring the semantic similarity between the call and the research of the applicants, we test whether those calls are made on research topics that could be of interest to female scientists. Our results suggest that gendered language in the calls have no effect on the application rate of women, but the agency may issue call of little interest to women, as they don't fit with their research interest.

In the third paper of this dissertation, we notice how the aim of the research agencies is to steer science in a particular direction that is deemed “important” by them. We then measure the research trajectories of the scientists in our sample in a neighborhood of 5 years around the call. We develop hypothesis on the research trajectories of non-applicants, non-winning applicants and winners. Furthermore, we test our hypothesis with a diff-in-diff model after full optimal matching on a call-by-call basis. We further test how those research trajectories change between male and female scientists. Our results suggest that female winners may be more trustworthy in the usage of grant financing.

VALUE INFUSION: DYNAMICS AND IMPLICATIONS FOR STRATEGY-MAKING

Luca Manelli - Supervisor: Prof. Josip Kotlar

Co-Supervisor: Prof. Federico Frattini

There is a growing interest by top executives and strategists in meaningfulness, worth and purpose within companies. This trend has triggered a (re-) discovery of important managerial themes, such as the importance of historical commitments with stakeholders, how organizations can be authentic and foster a higher purpose around individuals and organizational actions. However, these phenomena come often at odds with the reality of companies, which need to be economically efficient, innovative and future-thinking in order to survive and thrive in increasingly competitive and dynamic market environments. These tensions trigger higher complexity for managerial practice. This point out an important, yet understudied phenomenon: how a sense of worth and meaningfulness about the organization can be infused and maintained over time, and what are the positive consequences on innovation and strategy making. This phenomenon is problematic because, even though it is rising in fame in the managerial practice through popular business books, practitioners' articles and consulting companies reports, not much is known from a theoretically-driven, research

standpoint. This lack of research motivates the endeavor of the present dissertation to inform managerial practice that meaning and organizational purpose are not temporary management fashions that conceal or justify business-as-usual or opportunistic behavior by managers, but might have actually a positive impact on the transformation of contemporary organizations. While anecdotal evidence show that a sense of purpose and meaning in organizations can bring positive consequences, and emerging empirical research is showing it, we still do not know how this happens and why. Furthermore, while the concept of purpose at the individual level is relatively well established in micro-organizational behavior research as a function of either interpersonal leadership or job crafting, the lack of a settled definition of purpose at the organizational level makes it difficult for research to develop a somehow coherent body of knowledge around such concept in organization theory and cognate disciplines, like strategic management, since the validity of the construct itself comes into question. Using Giovanni Sartori's ideas on concept formation, the connotative element of

the construct "organizational purpose", which elicits emotional recalls of spirituality, humanism, trust, solidarity, and so on, in the minds of individuals, has way more importance than the denotative element, which strives to give a precise definition to the construct, with clear semantic boundaries, clear connection with cognate constructs, and also clear measurements. The theoretical sensemaking around these empirical and conceptual problems starts with the concept of "value infusion", coined by Selznick and defined as the process through which an organization comes to be infused with value beyond the technical requirements of the task at hand. Such value infusion is carried out by institutional leaders and institutionalizes the organization, which becomes an embodiment and a vehicle of a higher purpose that transcends the economic demands. Therefore, my theoretically-informed research goal is to investigate how value infusion unfolds in companies. I break down the overarching research goal in three sub-goals, which tackle three different "issues", or conceptualizations, of value infusion. Each of them corresponding to one of the

papers that are part of the present dissertation:

Research gap #1: Exploring the dynamics of purpose institutionalization, which consider value infusion as a *distributed meaning- and sense-making* issue,

Research gap #2: Elaborating the relationship between temporality and value infusion, which consider value infusion as a *historical consciousness* issue,

Research gap #3: Exploring the relationship between value infusion and strategy-making, which consider value infusion as a *strategic framing* issue.

In this dissertation, I focus on how leaders infuse value in organizations and what are the organizational and strategic consequences of it. In order to theoretically make sense of this empirical problem, I take a multi-theoretical approach, that starts with the stream of research that stemmed from the "old institutionalism", and integrates it with other theories that inform my answer to such research objectives, such as social-symbolic work, rhetorical history, collective memory and organizational identity. Consistently with a theory-building approach, I adopt qualitative research methods in order to unearth the rich, grounded understandings of individuals about worth and meaningfulness in organizations. The first paper focuses on the dynamics of purpose infusion in organizations, and how individuals make sense of the new organizational purpose as a social-symbolic object.

Using a longitudinal case study of a strategic change in an organization, we find that the effectiveness leaders' efforts in communicating and shaping members' understanding of what purpose is finds different obstacles. These obstacles are related to the perception of organizational temporality, where the non-stop sequence of activities and tasks leads to a perception of short-termism, which clashes with the aspirational and long-term view that purpose entails. Furthermore, they are also related to how members make sense and judge the consistency of actions of the leaders. Finally, we find that these obstacles can be overcome locally, by generating a sense of meaning through interpersonal interactions and support. The second paper is centered on the relationship between value infusion and history, and develops theory on how family business foundations connect the historical legacy of the family with current constituencies. Using a multiple case study, we find that the family legacy can be considered as an asset that can be leveraged to create resonance towards stakeholders, which connects the values of the family firm with stakeholders' values. The third paper focuses on the relationship between value infusion and strategy-making, unearthing the processual mechanisms through which value infusion can foster, and not just hinder, as most research has instead pointed out, the strategic flexibility of an organization. We find that in certain conditions,

organizational purpose can inform the cognitive frames that top managers use to scan the environment and identify new entrepreneurial opportunities. In this sense, organizational purpose expands the cognitive frames around "who we are" and "what we do" as a company, thus influencing the perception, selection and judgement of the consistency of new opportunities. However, organizational purpose presents a fundamental tension for companies. While it enables strategic renewal and growth when it is properly communicated and embedded in the company, it needs to be nurtured vis-à-vis stakeholders through the enforcement of authenticity and commitments, which oftentimes consist in foregoing potential growth opportunities. In so doing, the dissertation provides theoretical contributions to emerging research on organizational purpose, family business and strategic sensemaking. Furthermore, it also provides two main contributions to managerial practice. First, it highlights the importance of individual managerial skills in effectively frame and reframe what are the core features of the company in order to engage effectively in innovation and strategic renewal. Second, it stresses an often-overlooked element that helps infuse and sustain meaning and values in organizations effectively by leaders, that is, how individuals subjectively perceive history and identity in connection to the integrity of the organizational character.

THE ORGANISATIONAL IMPLICATIONS OF DIGITAL TECHNOLOGIES WITHIN PUBLIC SECTOR ORGANISATIONS

Giulia Maragno – Supervisor: Prof. Luca Gastaldi

Co-Supervisor: Prof. Mariano Corso

The dissertation presents the effort of conceptualising and investigating the multifaceted organisational processes and phenomena related to the uses of technological artefacts within public boundaries. The nature of this exploration is interdisciplinary, and its contributions entail public management, organisation science, innovation management, social science, information system, museum and cultural management, with respect to the final aim of Public Sector Organisations (PSOs), the creation of values for several publics. Nevertheless, it took me time to realise that public values are just the final impressions of a bigger picture and, to shed light on them, a step back was required to find the missing piece of this puzzle, the connection between organisational structures and technologies. The dissertation – exploring how digital technologies are pushing organisational innovation, changing processes, activities, and practices – joins the academic debate about the relations occurring among technological artefacts and the context in which they are implemented, a conversation that is gaining increasing attention

in the last years. As this focus is rather broad, the work is configured as a collection of four papers, each addressing a specific sub-objective to reach the overarching endeavour of this research.

The first paper maps the extant literature regarding the use of digital technologies within PSOs, to produce an understanding and interpretation of the academic debate. What emerges from this investigation is that most of the current studies are focused on the (expected) benefits exerted by digital technologies on users' needs, lacking to explore how they are entwined with organisational processes and dynamics. Informed by these findings, I decided to set aside the nexus of digital technologies and public values. Delving on these premises, and adopting abductive reasoning, the remaining studies empirically observe how technologies might become core agents of fundamental changes in organisational processes and practices.

The second paper, sampling Italian museums as an exemplary case of (public) organisations, casts light on how these organisations cope with the challenges to transform

themselves by leveraging on digital technologies. Results detect the existence of four main paradoxes that differently takes place along the macro, meso, and micro levels and how museums, as unstable and open systems, develop corrective rebalancing practices to navigate the innovation path, through the widening of their boundaries and the juxtaposition of various tensions.

Once framed the boundaries of the innovation agency and disentangled the paradoxes that organisations face while developing digital transformation initiatives, the third paper presents Artificial Intelligence (AI) as a case of technological artefact that is shaping human activities, bringing new challenges for organising. From these premises, the study narrows down the focus, scrutinising how PSOs might leverage the actions offered by the peculiar technological artefact. The answer comes by adopting a double theoretical perspective: on the one hand, the research pinpoints the factors that are tied to AI and the others that, instead, are common to standard technologies; on the other hand, it provides a suggested formalisation of AI

affordances and constraints within the given domain. With regard to the challenges brought out by AI, the fourth paper continues questioning the implications of a new technological agent – namely a chatbot – on the microstructure(s) of six PSOs across Europe. From a theoretical perspective, this study identifies a set of novel solutions that PSOs design to solve the four universal problems of organising that arise when AI is introduced. This set of solutions leads to the creation of a novel form of organising: the AI team. This novel microstructure, which is a multi-agent system (AI solution, AI trainers, public managers), demands a mutual human-machine interaction and interdependence, where each agent supports and complements the work of the other. Overall, this dissertation mainly contributes to organisational theory by advancing the understanding of the dynamics, tensions, relationships arising within organisational boundaries when embracing a digital transformation path. Moreover, by adopting an empirical approach, the work provides some novel insights to the recent debate concerning the need to deepen organisational functioning and phenomena

as twisted together with technological artefacts. Finally, keeping in mind the initial focus on public value as defining theme, this dissertation sets the ground for some new interpretations. As far as PSOs are part of broader social systems, the notion of public value enabled by digital technologies brings the relations among technological artefacts and human agents not just within organisational boundaries, but within system realities. Explaining these relations can be beneficial to cast light on the scale of technologies' implications for the constellation of individuals and organisations acting in the public arena.

Keywords: Public Sector Organisation; Digital Transformation; Organisation Science; Artificial Intelligence.

LOGISTICS 4.0 TRANSITION: CONCEPTUALIZATION AND DESIGN INSIGHTS

Tiziana Modica - Supervisor: Prof. Elena Tappia

Co-Supervisor: Prof. Claudia Colicchia

Managing logistics processes is a complex task that involves many stakeholders, different ownership of assets, and coordination among key actors such as shippers, carriers, logistics service providers, and customers. Market globalization, the growth of e-commerce, and the increased attention toward sustainability are some of the changes that further increase this management complexity by triggering the need for cost-effective, sustainable systems to keep pace with the current stakeholders' requirements. Managing this complexity requires new and breakthrough organizational and technical solutions. Cyber-physical systems (CPS), which are the focus of the Logistics 4.0 (L40) paradigm, could offer a possible answer for this management challenge, and they might turn the logistics process into a strategic weapon, enabling firms to improve both the efficiency of logistics operations and their service level, while achieving sustainability outcomes also in terms of environmental and social values. Despite the great opportunities claimed, confusion exists around the definition of L40, and empirical research able to explain how to

diffuse and apply 4.0 concepts is scant. Focusing on the conceptualization, diffusion, and integration of L40 into logistics processes, this thesis aims to contribute to the L40 transition to make companies benefit from the fourth industrial revolution. For this purpose, knowledge will be built on: (1) understanding how to design and configure L40 processes, (2) studying how L40 is diffused in practice and what role company size has in the diffusion of the fourth industrial paradigm for logistics, and (3) understanding how to integrate L40 in logistics processes by developing and studying real-life applications. A systematic literature review (SLR) was selected to define L40, and investigate how L40 affects the design and the configuration of the logistics process, and their evolution towards full L40 maturity. Building on the literature findings and Rogers' Diffusion of Innovation Theory, an empirical study was then carried out to collect practical evidence on the diffusion of L40 practices and offers insights into how companies are contributing to the digitalization of logistics processes according to their size. The empirical evidence

of the research was collected through an interview study involving 65 Italian logistics companies (i.e. logistics service providers, and shippers with logistics capabilities and assets) including 34 LEs and 31 SMEs. The last research step included the investigation of two L40 applications – one related to transportation and the other related to warehousing – aimed at understanding how to create the fit between the 4.0 solution and the logistics process, to support the successful integration of L40. New L40 approaches for managing the logistics processes were developed with the support of specific companies, and their performance was assessed and compared with the no-L40 base case. The first L40 application, which refers to transportation, includes a new managerial approach that integrates predictive trucks' estimated time of arrival (ETA) in truck scheduling to solve issues related to truck arrival time uncertainty. The approach exploits ETA information to reschedule trucks dynamically according to the up-to-date travel times. The second L40 application, which refers to warehousing, uses visual

color-coding information on picking locations provided through personal digital assistants to accelerate search and picking tasks for manual order picking. The performance of this solution was evaluated by the means of a triangulation approach that included the analysis of field data, a virtual reality experiment, and an online experiment.

The results of the research are formalized in a collection of four papers (three journal papers and one conference paper). This thesis shows that an "L40 process" is an evolutionary concept that should include three main principles: the automation of physical tasks and data collection, the integration of data among related processes and actors, and intelligent data analysis supporting decision-making and process improvement. It also proves that the L40 transition is an ongoing process, but the maturity of the technologies and solutions implemented remains low, and that size affects the way companies are shaping their transformation path. Indeed, LEs and SMEs are taking advantage of their main strengths to shape their digital transformation patterns and they are investing

in technologies and solutions that allow them to support and enhance their main source of competitive advantage. Besides, by developing two applications of L40 for logistics, this thesis highlights the integrated design of process and technology as a key aspect to successfully adopting L40 and it offers insights into the quantification of L40 benefits in logistics. Results offer both academic and practical implications. From a theoretical perspective, this study is one of the first research focusing on how the 4.0 concepts can be defined and applied in logistics processes. It also contributes to clarifying the L40 diffusion rate by offering empirical evidence and advancing the debate around the role of company size in determining organization innovativeness. From a practical viewpoint, this thesis clarifies the meaning of L40 and offers insights into how to design and manage the L40 transition process. Ready-to-use instruments that can support managers and workers in their day-by-day activities are also offered.

THE VALUATION OF ENTREPRENEURIAL VENTURES

Benedetta Montanaro

Supervisors: Prof. Massimo G. Colombo, Prof. Tom Vanacker

This thesis investigates the determinants of the valuation of entrepreneurial ventures, i.e. young firms created by one entrepreneur or more based on an innovative business idea. Understanding which factors drive the valuation of entrepreneurial ventures is a challenging task due to large information asymmetries, that make investors unable to distinguish good from bad firms and to correctly evaluate them. For these reasons, investors often consider the valuation of these ventures as a “gamble” and tend to rely on cognitive shortcuts and their “gut feeling” to evaluate investment targets.

In the attempt to provide practitioners with theory-based guidelines, and to support their evaluation process, scholars have focused on identifying factors that alleviate information asymmetries by signaling ventures’ quality. Despite the achievements of these works, our understanding of the drivers of ventures’ valuation is still limited. First, the literature on the determinants of entrepreneurial ventures valuation is extremely fragmented. Existing studies mainly provide an incomplete outlook, focusing disjointedly on specific financial milestones. This creates a compelling need for a

unified framework. Second, the majority of previous studies on entrepreneurial venture valuation deals with venture capital (VC) rounds and initial public offerings (IPOs). Other financial milestones, like acquisitions or equity crowdfunding (ECF) received less attention. This is an important gap, considering that the context in which valuation is observed, the extent of information asymmetries and the factors that reduce the negative impact of these information asymmetries differ across different financial milestones. Third, the introduction of new digital financing channels (e.g., crowdfunding), that allow retail investors to directly invest in entrepreneurial ventures, further challenges our understanding of the drivers of valuation. This change has also increased the diversity in the sequence of financial milestones that ventures go through along their lifecycle, with important and under-investigated implications for valuation.

This work tackles the previously described gaps through a collection of papers. In Paper 1, I conduct a systematic literature review looking both backwards, to create order in what we already know about the drivers

of entrepreneurial venture valuations, and forward, to identify new promising avenues for future research. In this paper, I develop a map highlighting how and why the drivers of venture valuations and their underlying theoretical lenses vary across different milestones along the ventures’ lifecycle.

Paper 2 deals with the dual tracking phenomenon, investigating whether going through an IPO before being targeted for an acquisition interacts with signals generated by being VC-backed in determining the valuation at acquisition. In other words, this study explores how a sequence composed of multiple signals characterized by different strength influences valuation. Results show that going through an IPO in a stock exchange different from the NYSE or NASDAQ (thus generating a weak signal) has a negative effect on the valuation at acquisition of ventures that are backed by highly reputable VCs (i.e., a strong signal). This effect is so strong that the resulting sequence of signals is not positively associated with acquisition valuation. In other words, the positive effect of the initial strong signal vanishes if firms subsequently convey a weak

signal. Conversely, a sequence composed by a weak signal (being backed by less reputable VCs) followed by a strong one (listing in the NYSE or NASDAQ) does have an overall positive effect on ventures’ valuation at acquisition. This paper contributes to an emergent branch of the signaling literature that has challenged the “mechanistic understanding of signaling”, discarding the traditional assumption of fully rational signal receivers and investigating alternative behavioral hypotheses. Indeed, in this paper I integrate signaling theory with information processing theory, suggesting that signal receivers may overreact when interpreting a sequence of contrasting signals of different strength. Being affected by the “recency” and the “hot hand” cognitive bias, receivers overestimate the effect of the latest signal in a sequence, especially if weaker than the previous ones, and extrapolate a trend of signals’ strength that influences their predictions of the sender firm’s future quality.

Paper 3 studies how the effectiveness of signals in determining the valuation of entrepreneurial ventures in acquisitions is moderated by the number and the characteristics of prospective acquirers interested in buying the target. In this paper, I leverage on the fact that prospective acquirers have heterogeneous information set on the target – because they can operate in the same industry as the target, or be geographically close to the target’s premises,

thus having a higher probability to be informed about the target; or they can operate in other industries and be located in countries geographically far from the target’s premises, thus having a higher probability to be poorly informed about the target. Specifically, with this paper I contribute to signaling theory by introducing into its construct a measure for information asymmetry. This context allows me to explore how signals’ effectiveness changes on the basis of who are the signals’ receivers and how well-informed they are. Results show that the signals’ positive effect on the valuation at acquisition is stronger the higher the number of poorly informed prospective acquirers interested in buying the target. On the contrary, the signals’ positive effect is more limited if the number of prospective acquirers highly informed about the target increases.

Last, in Paper 4 I investigate the effect of being VC-backed before going through an equity crowdfunding (ECF) campaign, on the pricing of entrepreneurial ventures’ shares in equity crowdfunding. This work shows that VC-backed firms obtain higher pricing than non-VC-backed firms but are not less likely to fail or more likely to perform better after the campaign. We draw from signaling theory and information processing theory and we suggest that being VC-backed before the campaign is a false signal in the ECF domain, since it does not create a separating equilibrium between high-quality

and low-quality firms in the long-term. However, the crowd in the ECF campaign misinterpret it as a true signal, recognizing higher pricing to VC-backed companies. With this paper, I contribute to the stream of literature suggesting that, even when the signaling environment is not noisy and signals are easily observable, different receivers in different contexts may interpret signals differently.

My thesis primarily addresses scholars interested in the valuation of entrepreneurial ventures, in the fields of entrepreneurship, management, finance, and economics. Nevertheless, it also provides important practical implications. In particular, the discussions that it stimulates are of interest to practitioners, either founders of entrepreneurial ventures or external equity investors dealing with entrepreneurial ventures’ valuation. Moreover, thanks to the disintermediation of access to external equity finance brought by new digital financing channels, this topic is becoming increasingly relevant for platforms that offer ordinary citizens the opportunity to invest and for the retail investors populating these platforms. Finally, this study is also beneficial to policymakers, as entrepreneurial venture valuation is a key element for the development of effective and self-perpetuating entrepreneurial ecosystems.

BUILDING SUSTAINABILITY AND RESILIENCE IN INDUSTRIAL SUPPLY CHAINS: THE ROLE OF PRACTICES AND PERFORMANCE MEASUREMENT IN LINKING SUPPLY CHAIN SUSTAINABILITY AND RESILIENCE

Marta Negri – Supervisor: Prof. Enrico Cagno

The current industrial system has been receiving increasing pressure to improve its level of sustainability and resilience. Indeed, stakeholders and policy makers are urging firms to engage in an ecological and ethical transition, that allows firms to thrive while preserving the environment and communities; in addition, firms are asked to boost their level of resilience, as supply chains are increasingly vulnerable and complex, and disruptions become more frequent and more severe. Sustainability and resilience are both fundamental for healthy, thriving supply chains. Although these two concepts have been studied mostly separately, there is interesting initial evidence that sustainability and resilience influence each other and should therefore be studied together. Indeed, in the extant literature there are examples of both detrimental applications, in which one is enhanced to the expenses of the other, and synergic applications, where sustainability and resilience are consonant. It is necessary to better study the two concepts, understanding how to enhance the level of both sustainability and resilience and monitoring

progress through adequate performance measurement frameworks. Being the link between sustainability and resilience a nascent research stream, the past literature still does not provide established knowledge on the concepts, practices and performance measurement. Stemming from a literature review, the objective of this thesis is to study the relationship between sustainability and resilience in supply chains. This objective has been pursued by means of two research questions: RQ1: *“How to implement sustainable and resilient supply chains?”*; RQ2. *“How to measure the sustainability and resilience performance in supply chains?”* This thesis consists of a collection of six papers, with different focus to answer to the two research questions. In detail, Paper 1 performs a systematic literature review to explore how the concepts have been explored in the past literature, identify research gaps and pave the way for future research. Paper 2 provides an initial understanding of how to implement sustainability and resilience in supply chains, by analysing the outcomes experienced from implementing the practices. Paper 3 bridged practices and

performance measurement, focusing on supply chain resilience and providing a novel system of practices, connecting them to the indicators of resilience. Paper 4 focuses on supply chain resilience, providing a performance measurement framework built from the extant literature and preliminary validated with manufacturing firms. Paper 5 focuses on sustainability – intended as a broad concept, including circular economy and industrial symbiosis – providing an integrated, multi-level and scalable framework for performance measurement. Finally, Paper 6 focuses on both sustainability and resilience performance measurement, proposing a way to link the two concepts via performance and capabilities. Papers 4, 5 and 6 also provide insights on the relationship between the two concepts. This thesis shows that there are interesting synergies between sustainability and resilience, that should be exploited for the implementation and for performance measurement. It also asserts that there is a fundamentally positive relationship between them, if a long-enough time horizon is considered. The thesis also

proposes that the concept of capabilities could be an interesting way to link the two concepts. These results provide advancements to the literature, providing insights that may stimulate the debate among academics. Besides, practical tools to facilitate implementation and performance measurement are provided to practitioners. Finally, some conclusions drawn here may be used by policy makers to build sustainable and resilient industrial supply chains.

A NOVEL METHODOLOGY FOR CAPABILITY-BASED EMERGENCY MANAGEMENT IN COMPLEX SYSTEMS

Mariachiara Piraina – Supervisor: Prof. Paolo Trucco

Modern societies are vulnerable to a wide set of physical, cyber and social threats. Several past and recent events demonstrated the relevance of Emergency Management (EM) for the resilience of complex systems. Due to their interdependencies, dynamism, and geographical extension, complex socio-tech systems, are subject to long and wide domino effects. In these complex socio-tech systems, emergencies are intrinsically severe and challenging to be properly managed. It results that effective emergency management system is key for the resilience of socio-tech systems. This is a relevant issue since modern societies rely on multiple complex socio-tech systems where Critical Infrastructure (CI) represents the main field where this issue can be studied. Considering the management of emergencies, scholars and practitioners moved the attention from a procedural approach (based on plans, procedures, and event scenarios) to the adoption of a capability-based planning approach (based on building adaptability to unpredictable circumstances independently from event scenarios) which is advocated to promote higher systemic resilience. The aim of this research is

to contribute to fostering a capability-based approach for emergency management in complex systems to improve overall system resilience. It means leveraging on a wide set of capabilities with the aim of safeguarding people, guaranteeing the physical integrity of critical assets and the continuity of operations. In the context of this study, a capability can be generally defined as the “description of an [organization’s] ability to do something” and can be considered an appropriate task an organization can execute when a disruptive event occurs to minimize the resulting negative consequences for the stakeholders. Although the benefits of implementing a capability-based approach are advocated by both scholars and practitioners, how to plan and align intra- and inter-organizational EM capabilities to maximise a resilient response to emergencies is an open issue in the extant literature and the research on the topic is still limited. Despite the large majority of existing contributions is mainly of theoretical nature, a coherent methodology for the analysis and assessment of EM capabilities is lacking. Most of the contributions are focused on case-specific applications,

results are sector-specific and not transferrable to different operational contexts. Given the presence of different features that characterise an EM capability, its operationalisation requires a full understanding of the organisational structure, the operational and decision-making processes of the involved actors, as well as the collective performance when an emergency occurs. Based on the above considerations, the general research question of the present thesis is: *How to plan emergency management capabilities for enhancing the resilience of interdependent systems?* It can be turned into more specific and researchable research questions: 1) *What are the core intra- and inter-organizational capabilities for implementing effective emergency management in complex interdependent systems?* 2) *How can the intra- and inter-organizational emergency management capabilities of complex interdependent systems be modelled?* 3) *How to assess intra- and inter-organizational capabilities within a multi-actor EM system?* The entire research is grounded on two main theoretical bodies: Socio-technical systems with a focus on Complex Adaptive

Systems, and Resilience Engineering through the Safety-II approach. The thesis is structured as an edited collection of four papers that propose a methodology for the analysis of EM capabilities. *Paper 1* investigates the first two research questions and proposes a comprehensive classification of EM capabilities that can be adopted by different actors thanks to its generalized and standardized features. Moreover, it includes a framework for modelling the capabilities providing a univocal and structured method for describing and representing a system through standardized elementary components. *Paper 2* contributes to the first research question through the testing of the EM capabilities classification in the context of collaborative capability building practices for critical infrastructure resilience. *Paper 3* investigates the third research question and proposes a methodology for assessing the capabilities by making use of the Functional Resonance Analysis Method (FRAM). A set of indicators was developed to provide valuable information on the functional behaviour of the system, thus providing insights on the possibility to leverage on some capabilities to improve the

EM system and consequently the overall system resilience. Finally, *Paper 4* contributes to all the research questions by applying the methodology for EM capabilities classification, modelling, and assessment in a real-world application in the transport domain, where cross-border cascading effects of accidents and thus cross-country EM collaboration are envisaged. The results contribute to the research stream on EM by proposing a viable capability-based approach that enhances the resilience of complex socio-technical systems against disruptive events. The EM capabilities classification overcomes the existing lacuna in the literature which is mainly focused on application-specific and context-specific contributions and on broad lists with similar capabilities. The framework for EM capabilities modelling addresses the lack of a generalized approach. In this regard, the developed capability-based approach is opposed to traditional scenario-based approaches. The results also originally contribute to the FRAM literature by expanding its adoption to the EM context for studying the intrinsic characteristics of a capability-based EM system.

Therefore, this study is of interest to researchers thanks to a robust conceptualisation and operationalisation of the capability view in the EM context, and to practitioners looking at the implementation of effective collaborative capability planning during all the phases of the EM cycle. Practitioners are provided with general guidance for implementing the framework in different contexts. Moreover, the implementation of the methodology guided the development of an IT platform for cross-border EM collaboration. However, there are some limitations that could be addressed as future developments of this research such as the possibility to investigate the dynamic characteristics of the system and apply the methodology in different contexts.

MODELLING ONLINE USER-GENERATED TEXTS FOR PERFORMANCE MANAGEMENT OF PUBLIC INSTITUTIONS: THE STUDY OF ITALIAN STATE MUSEUMS

Paola Riva – Supervisor: Prof. Deborah Agostino

Public management has largely recognized the potential of exploiting data shared online by users but empirical applications showing actual usage of users' online voices for performance management of public institutions are yet understudied. Extant studies on performance management in public sector have relied on answers to surveys or on manual analysis of online activities of users. However, public management literature still pushes towards deeper investigations of how public organizations can further their performance management defining subjective indicators based on users' thoughts. Engaging with this debate, my dissertation enriches knowledge on whether and how automatic models of online User-Generated Text (UGT), like social media posts and online reviews, inform performance management of public institutions. Decomposing this wide and complex phenomenon at the intersection of different disciplines through the Input-Process-Output (IPO) model, I develop a collection of four research papers which contribute to the three components of the phenomenon under scrutiny. In terms of *input*, notwithstanding the interest around UGT of performance measurement

literature in public sector, there is yet lack of clear methodological guidelines on how to automatically model online UGT to inform performance measurement of public institutions. Therefore, the first research paper of my dissertation systematically reviews academic studies that refer to performance measurement of public institutions and automated modelling of text, *i.e.*, Natural Language Processing (NLP). Answering "which NLP methodologies have been used to support performance measurement in public sector and which are the implications of their usage for public sector decision makers?" the paper significantly contributes enriching knowledge about the *input*, showing that the debate is extremely focused on just few of the possible NLP tasks and that public management experts are yet left without examples nor explanations of the decision-making implications of the addressing specific NLP tasks. In terms of *output* of informing performance management of public institutions through automated models of online UGT, public management literature provided empirical evidence of performance measures based on users' perspectives just by means of *counts* of users' interactions on social media and it discussed

the adoption of online UGT just as *potential* sources to support public sector decision-making, without providing empirical evidence of which performances of public institutions are measured by means of automated modelling of wide sets of online UGT and how to measure them. In light of this, the second and third papers quantitatively analyse online reviews associated to Italian state museums on TripAdvisor, and they empirically show how it is possible to identify highly personal aspects of users' perceptions of public performances by means of the automated analysis of online UGT. These papers strongly contribute to the study of the *output*, showing how to derive flexible and dynamic performance measures from the perceptions of users to inform public institutions without the need to ask them to provide specific personal information on who they are and where they come from, but just considering the written language they use online. In terms of *process* of informing performance management of public institutions through automated models of online UGT, public management literature has focused on the design of individual performance indicators based on online users' data but the implications of the actual usage of a performance measurement

system based on online users' data is yet an underexplored topic. In light of this, the fourth paper empirically answer to the research question "how is a performance management system based on data generated online by users designed and used by public sector institutions and which are the accounting and accountability implications?" by means of a longitudinal case study of the design and use of a performance measurement system based on digital data by a central government and its controlled units, respectively Italian Ministry of Culture and 100 Italian state museums. The paper finds that though the designed metrics are not fully understood by the museums, the system is understood by means of the connections among performance measures and the dynamics that emerge from the usage of measured results. These findings contribute enriching knowledge about the *process* of informing performance management of public institutions through automated models of online UGT, providing empirical evidence on the accounting and accountability challenges encountered along the process that leads to the definition of the management decisions in connection to the usage of automated models and algorithms. My dissertation mixes various methodologies – systematic analysis of documental material, quantitative analysis of online UGT of public institutions, and qualitative analysis of the implementation of a performance measurement system for public sector based on online UGT – and

different empirical samples – the 30-top visited Italian state museums studied in the third research paper to the 100 Italian state museums analysed in the second and fourth research paper – to verify across different methodologies and different samples the findings about the phenomenon of informing performance management of public institutions through automated models of online UGT. The empirical setting of my dissertation is represented by Italian state museums, a particularly fertile ground for the investigation of the phenomenon under scrutiny. State museum performance measurement is strongly intertwined with the perceptions of the users, since museums have in their own mission a strong societal orientation that already poses users at the centre. The openness of museums to users' perspectives is strongly aligned with the call for more dynamic, customized and innovative performance measures for public institutions. Moreover, the already strong connection between users' expressions and experiences is further pushed by more participatory approaches experimented by museums, where users are encouraged to actively participate to the creation of online contents and narratives to contribute creating cultural value. Besides being the first country worldwide in terms of UNESCO World Heritage sites, Italy has been selected due to the recent digital push of the Italian government to encourage museums to nurture audience engagement and collaborative processes also

through online channels such, as social media platforms, even that contributed to the nowadays dramatically increased adoption of these platforms. Researching at the crossroad of Performance Measurement, Public Management, Text Modelling and Online User Behaviour Analytics, my dissertation is relevant for different audiences. Overcoming generic discussions on the potential contributions of Artificial Intelligence (AI) for public management, my dissertation offers public management scholars indications on the implications that assumptions on text data sources and NLP models have on the performance measurement of public institutions. Performance measurement scholars find interesting considerations on accounting and accountability aspects along the phases of the measurement process connected to the development of flexible and agile forms of measurements able to adapt to the rapid evolutions of society. Also, the practical-oriented nature of my dissertation makes it interesting for practitioners, such as policy makers, who find examples of the potential biases that can be introduced in defining standards and guidelines for performance measurement in public setting based on online UGT and can consider the approach of this dissertation to facilitate the alignment of service delivery objectives of public institutions with wider societal and civic purposes of the public institutions.

THE IMPACT OF ADDITIVE MANUFACTURING ON SC DESIGN, STRATEGY AND PERFORMANCE

Alessio Ronchini – Supervisor: Prof. Antonella Maria Moretto

Additive Manufacturing (AM) is one of the six “Smart Technologies” included in the Industry 4.0 plan by the European Commission (European Commission, 2015). Also known as 3D printing, AM is a manufacturing technique that creates an object by adding material layer by layer instead of extruding it from a block. Thanks to this characteristic, it allows design freedom in the ideation and creation of products, otherwise not possible with traditional manufacturing (Attaran, 2017). The technology, initially used for “Rapid Prototyping”, is now used also to produce tools (“Rapid Tooling”), components and final products (“Rapid Manufacturing”) (Hopkinson, et al., 2006), finding applications in several sectors, such as automotive, aerospace, healthcare and biomedical, oil&gas. Especially during the Covid-19 period, AM has practically shown its characteristics, proving to be an excellent source of resilience and flexibility for many companies and the society (Arora, et al., 2020; Meyer, et al., 2022). The diffusion of the technology has recently accelerated and the market growth has recorded a CAGR of 17% between 2020 and 2023, with a registered worth

value of USD 12.6 billion in 2020 and an expected worth value of USD 37.2 billion in 2026 (Statista Research Department, 2022). Despite the rapid expansion, AM is still remaining a niche technology, especially for metal applications. Printing metals is generally less common than plastics since the equipment and raw materials (e.g. aluminium, titanium) are generally much more expensive. Moreover, the metal application is a slower process, inhibiting the series production of metal components. The industrial applications have then raised questions regarding the potential impacts of the technology on other processes beyond the production itself, broadening the scope to the whole Supply Chain (SC). In fact, AM adoption influences almost all processes along the whole chain, from supplier relationship management to planning, as well as distribution and customer management (Oettmeier and Hofmann, 2016; Luomaranta and Martinsuo, 2019). Among the first authors, Holmström, et al., (2010) set a research stream aimed at studying new possible SC configurations enabled by AM adoption, together with Khajavi et al. (2014), Liu et al. (2014), Savastano et al. (2016) and Braziotis et al. (2019). All

these authors proposed two SC configurations that are a centralized and a distributed configuration, according to the choice of deploying 3D printers in a central hub or distributing them along decentralized and local hubs close to customers. Moreover, Tuck et al. (2007) studied the impact of AM adoption on Supply Chain Management (SCM) strategies, suggesting that AM is a technology that well fits with both the lean and the agile strategies, proposing the so called “leagile” strategy. In turn, also SC performance metrics are affected, as demonstrated by Liu et al. (2014) that applied the SCOR model to evaluate and assess the impacts on SC performance, and opened a research stream aimed at assessing the impacts on economic, environmental and social SC performance. Accordingly, this research aims at studying the impact of AM adoption on SC design, strategy and performance based on a theoretical framework that was built on the results of a structured literature review (SLR). Indeed, an SLR has been conducted to identify the relevant variables, research streams and literature gaps. This research wants to discover the role of drivers and barriers towards

AM adoption and relate these variables to the company choice regarding potential changes in terms of SC configuration, with a particular focus on the upstream side and on the make-or-buy decision that AM adoption implies. This is a topic that is underexplored by academics, but relevant according to some few preliminary studies (Oettmetier and Hofmann, 2016; Kunovjanek and Reiner, 2020; Kunovjanek, et al., 2020; Friedrich, et al., 2022). Finally, changes that occur at an SC level impact in turn SC performance with an impact on some operational parameters in terms of cost, time and quality, but also with an effect on other different dimensions such as the resilience and flexibility, or the environmental and social ones. Thus, our objective is also to study the effects of AM adoption on economic, environmental and social SC performance. To achieve the abovementioned research objectives, we use in this research four methodologies: i. systematic literature review, to structure the existing knowledge and develop a research framework; ii. case study methodology, to provide empirical evidence supporting the theoretical framework derived from the academic literature, thus filling a gap in research; iii. focus group with experts, to perform an exploratory data collection regarding the potential impacts of AM adoption on sustainability performance; iv. Delphi method, to validate the results of the focus group, forecast the potential impacts that AM adoption

may have on sustainability performance, and explain these results with qualitative information collected from AM experts.

Thus, the overall question this research wants to answer and that drives the overall investigation is: *What is the impact of Additive Manufacturing adoption on supply chain design, strategy and performance?* This research wants to contribute to enlarging the current knowledge about the potential implications that AM adoption may have on SC design, strategy and related performance. The systematic literature review's contribution is the organization of the current knowledge on the topic, formulating a structured framework that considers several variables: i. drivers and barrier towards AM adoption; ii. the effects of AM adoption on SC design, with a specific focus on supply network, and on SC strategy; iii. the effects on SC performance, categorized according to the economic, environmental and social dimensions. We contribute by identifying the effects of AM adoption on SC linkages, with a specific focus on the supply network in terms of impact on the supply base and on the buyer-supplier relationship. Moreover, the identification of 4 patterns of AM adoption in terms of make or buy choice, namely *make, buy, make and buy* and *vertical integration*, has led to the validation of the other studies on this topic, and we add another pattern that

is named *vertical integration*. Then, another contribution relates to the identification of two additional dimensions of SC flexibility (*logistics* and *spanning*), compared to the three that have been already studied in literature (*production, sourcing* and *postponement*). Finally, this research contributes by clustering the areas of impact of AM adoption on SC sustainable performance. In terms of environmental performance, we propose as potential impacts area the CO2 emissions, level of inventories, optimization of material used, production waste, recycling and circular programs, and energy consumption. While, for social sustainability we propose as areas of impact the workers' conditions, workers' competences and skills, co-value creation with customers, and the development of local economies. For each of these areas, the research has led to the identification of the related impacts.

EVALUATION OF UNIVERSITIES' INSTITUTIONAL EFFICIENCY AND PERFORMANCE UNDER SYSTEM-LEVEL REFORMS IN RUSSIAN HIGHER EDUCATION

Ekaterina Shibanova – Supervisor: Prof. Tommaso Agasisti

Co-Supervisor: Prof. Evgeniy Terentiev

The Introduction of New Public Management in response to budget cuts amid increasing participation in higher education remains a global trend. Although it is not implemented in the same way and to the same extent in different national contexts, performance-based funding schemes, cost-sharing mechanisms, promotion of competition, excellence and efficiency are present in many countries. The widespread diffusion of performance-enhancing policies makes the provision of causal evidence on their effects particularly relevant. The thesis presents comprehensive evidence on the effects of performance-oriented reforms in higher education in terms of public universities' efficiency, productivity and research performance by addressing the case of the Russian higher education system during the period 2012-2020. The thesis is composed of five papers. The starting point of the study is a systematic review of research on the New Public Management production function indexed in Scopus, Web of Science, and EBSCOhost publication databases. Based on a final selection of 32 relevant studies

in the field, the thesis proposes a typology of performance enhancing policies: 'state as financier', 'structuring state', and 'autonomy steering state'. Within the 'structuring state' stream of policies, the thesis concentrates on the Russian case of an excellence initiative, Project 5-100. Using a three-step methodology of propensity score matching, Data Envelopment Analysis, and the Malmquist index, the study concludes that concentrating resources in a limited number of universities, aimed at enhancing their international competitiveness, was successful in improving publication performance and organisational productivity. The excellence initiative might have also produced spillover effects on universities with similar production possibilities not included in the reform. The effects of 'state as financier' regulation is explored using the example of a performance-based funding scheme. A combination of time series clustering and semiparametric difference-in-differences revealed the presence of beneficial redistributive effects of enhanced competition across higher education providers. The reform significantly transformed universities' production functions,

namely, in increasing the admission quality, the degree of internationalisation, and research performance. At the same time, the introduction of performance-based funding disproportionately benefited well-performing institutions that are already receiving greater resources and thus intensified stratification in the system. By discerning between formal and informal institutional autonomy and integrating the Benefit-of-the-Doubt, Data Envelopment Analysis, fixed effects regression, and instrumental variable approaches, the thesis studies the effects of the 'autonomy steering state' mechanism in higher education. The analysis demonstrates that current regulation on institutional autonomy in Russia does not contribute to any differentials in research performance and efficiency between autonomous and non-autonomous universities. Informal autonomy, and especially universities' autonomy in staff management, is a more robust positive predictor of efficiency gains. Finally, the thesis discusses the unintended consequences of the adoption of New Public Management and analyses the evolution of universities'

teaching and research production functions through Data Envelopment Analysis, Malmquist index, and sigma- and beta- efficiency convergence measures. Over almost a decade of performance-enhancing policies, and specifically under overlapping quality-assurance policies, Russian universities, on average, became slightly less efficient, but more homogeneous in their teaching efficiency. On the contrary, presumably due to a range of policies increasing the research capacity of comprehensive universities, research efficiency in the system increased, but the gap between the best and the worst performers in terms of their production possibilities became more evident.

The study first contributes to the discussion about universities as complex economic organisations with a production function that can be subject to change through building an incentive-constraint environment. Second, it challenges the economic justification of such regulation by taking advantage of a unique opportunity to address the research gap of fragmented evidence in the field and study the effects of several types of performance regulation on a single empirical context. From the methodological perspective, the study provides a range of novel combinations of empirical methods that allow a reduction in the endogeneity bias and an increase in the causality of evidence produced. In doing this, the dissertation informs policymakers, proposes possible

policy implications and fosters research in the field of policy evaluation in the public sector.

Policy implications

The study allows us to formulate applications for policy makers and practitioners in the field. For countries in the process of transforming institutions and regulatory mechanisms, and facing financial shortages, NPM is an effective way of developing higher education systems. Firstly, the research has shown that the promotion of competition and the introduction of performance-based funding mechanisms have the potential to change the productive functions of universities. In the long term, the transformation of the production functions and internal management mechanisms in universities has positive effects in terms of the impact of educational institutions in the development of the economy and society. Second, the mechanism of resource concentration in a limited number of leading national universities shows effectiveness not only in enhancing the universities of excellence, but also because it produces positive effects on second-tier organisations. Thirdly, although NPM has a number of negative stratification effects, in the medium term it appears to be a justified measure for the development of national education systems. The next implication is that competitive funding mechanisms can be modified to take into account the efficiency and

productivity of universities (the ability to transform resources into results), rather than just gross performance indicators. Such a mechanism takes into account the organisational resilience of universities – the presence of efficient management in the context of limited resources and an unfavourable external environment. Targeted programmes for the development of efficient universities trapped in underfunding are also possible. Such universities can act as anchor organisations that play a critical role for the social integration of the local community and the development of the regional economy. Further development of NPM could take into account the stratification consequences discussed above (the Matthew effect). Potential mechanisms could include designing mentoring programmes for universities of excellence with less successful organisations; creating flexible funding criteria that take into account varying university profiles and specialisations in different missions and activities (education, science, social impact, and the third mission); designing supportive development programmes that are essentially aimed at second tier universities.

TOWARDS DECENTRALIZED ORGANIZATIONAL MODELS AN ANALYSIS OF THE DESIGN AND GOVERNANCE OF BLOCKCHAIN PLATFORMS AND APPLICATIONS

Giacomo Vella – Supervisor: Prof. Luca Gastaldi

Decentralization has been a topic of interest across multiple disciplines, from computer to political sciences, and is becoming an increasingly discussed topic also in managerial academic literature (Hoffman et al., 2020). At its core, decentralization involves the dispersion of power and decision-making away from a central authority or entity, often resulting in a more distributed and collaborative system. While the definition and the advantages of decentralization are still debated (Chen et al., 2020; Vergne, 2020), it is clear that the emergence of new technologies has enabled the creation of decentralized systems that were not possible before, leading to new possibilities for innovation and collaboration. Recently, among the emerging technologies, the advent of blockchain has raised the prospect of achieving unprecedented levels of decentralization, leading scholars in management to examine its nature and scope (Chen et al., 2022; Hsieh & Vergne, 2022). Blockchain has been introduced in 2008 as the underlying technology of Bitcoin. With Bitcoin, for the first time, value could be reliably transferred between two distant, untrusting parties without the need of

an intermediary (Catalini & Gans, 2016; Zamani & Giaglis, 2018). Since the end of 2015, however, blockchain started gaining traction (Swan, 2015), gathering the interests of both academics and practitioners. Blockchain offers a way to enforce agreements and achieve cooperation and coordination that is distinct from both traditional contractual and relational governance as well as from other information technology solutions (Lumineau et al., 2021). Blockchain has hence emerged as a technological solution capable of redesigning interactions and coordination in business, politics and society, allowing to handle situations requiring coordination across heterogenous stakeholders in a way that challenges the traditional hierarchical structures (Atzori, 2015). Attempting to fulfill the promises of decentralization, organizations are adopting blockchain in different ways: from the use of cryptocurrencies (Aste et al., 2017) to the introduction of general-purpose platforms not tied to a specific use case but offering blockchain infrastructure to develop applications through APIs (Weking et al., 2019). This second approach enable other players to build decentralized applications

(DApps) exploiting blockchain potential (Angelis & Silva, 2019). Hence, in order to explore the impact of decentralization brought by blockchain technology, it is necessary to identify its effects on two different layers (Chen et al., 2021), as they may be related to different dynamics and have different levels of decentralization. Literature on digital platforms suggest that different layers of a platform may face varying design constraints that can influence the decentralization of governance structures (Chen et al., 2021; Constantinides et al., 2018; Reuver et al., 2018). For instance, the Internet is a foundational platform of the infrastructure layer and is governed in a relatively decentralized manner (Cerf, 2012; Johnson et al., 2004). However, applications built on top of the Internet infrastructure, such as Uber and Twitter, tend to be more centralized (Chen & Bellavitis, 2020). The differentiation between infrastructural blockchain platforms and the applications that can be built on them is explicitly defined in the classification proposed by Chen (2021). According to this classification, an infrastructure layer aims to become the common infrastructure for a

wide variety of applications, while an application layer tends to serve different solutions with a more narrowly defined domain. In the management literature, blockchain infrastructure layer is primarily studied through the lens of platforms (Chen et al., 2021; Constantinides et al., 2018; Hsieh & Vergne, 2022; Schneider et al., 2020). Even though there may be platform-based business models at the application layer as well (Trabucchi et al., 2020), given the lack of management literature on the blockchain infrastructure layer, we study it adopting a broad perspective of platforms. Therefore, the current investigation regarding blockchain decentralization is structured based on the following categorization: *Platform or infrastructure layer* as the blockchain itself; a blockchain can be a platform, and we refer to this as a platform of the infrastructure layer; at the infrastructure layer, a project needs to secure its distributed ledger, establish distributed consensus, and offer tools to developers; *Application layer* as a project built on top of an existing blockchain to serve end-users with specific needs; an application can also be a platform, and we refer to this as a platform of the application layer; at the application layer, a project often focuses on creating business logics and user interfaces that can serve end-users with specific needs. Despite the relevance of the changes that blockchain could bring, current research is still predominantly focused on

technological aspects and anecdotal applications. Knowledge is lacking for both academics and practitioners who, despite the progress in technology adoption, still struggle to have a clear understanding of the potential impacts of blockchain. To fill this gap, this PhD thesis has an overarching goal that unites all the articles constituting it: to investigate how the decentralization enabled by blockchain affects the organization and governance of digital platforms and of the applications built on them. Hence, the project is organized around three interrelated and complementary research objectives: Understand how decentralized platforms can be created with a peculiar emphasis on how the role of the platform leader changes when there is not a platform owner, but instead, the platform is created and managed by a group of different actors that can also be the users of the platform itself. Understand the role of the different stakeholders involved on a decentralized platform, with particular focus on how relevant they are, and which is their level of readiness in adopting blockchain technology. Understand how decentralized applications are governed. Who holds decision making power, how is it dispersed among stakeholders, which and how key decisions are made and enforced in their governance. The achieved results, articulated through a collection of papers, provide implications to both

academics and practitioners. As the growing interest in the intersection of decentralization and blockchain has resulted in a diverse body of literature, this thesis offers distinct perspectives through the lenses of organizational design and platforms. More specifically, the research offers new insights on blockchain and decentralization in four key areas: analyzing the different elements of a blockchain solution and their impact on decentralization, examining how these elements affect the success of creating blockchain platforms and applications, analyzing the impact of decentralization on the governance of blockchain applications, and proposing an overview of the intricate interplay between applications and platform infrastructure necessary for effective decentralization. The findings of the research also provide practical implications for organizations and managers. The study offers frameworks and guidelines for implementing decentralization through blockchain, which can help companies struggling to create blockchain ecosystems and gain a better understanding of how they can create value. The research also provides relevant indications on how to navigate the complexity of blockchain solutions and decentralization, while understanding their potential benefits and challenges.