International Journal of Innovation and Technology Management
Vol. 18, No. 5 (2021) 2050025 (25 pages)

DOI: 10.1142/S021987702050025X

World Scientific
www.worldscientific.com

Digitalization-Based Innovation — A Case Study Framework

Mico Apostolov*
Kristi Misirkov b.b. P. O. Box 201, 2000 Stip, Macedonia Dipartimento di Management, Università Ca' Foscari Venezia, Cannaregio 873, 30121 Venezia, Italia
mico.apostolov@ugd.edu.mk

Nunzia Coco
Dipartimento di Management, Università Ca' Foscari Venezia, Cannaregio 873, 30121 Venezia, Italia
nunzia.coco@unive.it

Received 30 January 2020
Accepted 8 May 2020
Published 8 September 2020

Small- and medium-sized enterprises (SMEs) have been leading innovation processes, where the upsurge of digital technology has overpowering implications on competitive positioning, firm's value chains and overall business model. Value creation facilitated by emerging digital technologies alters costs, as well as process performance. Due to field research and in-depth interviews with owners and managers of SMEs in North-East Italy area, we combine and analyze evidence of the contingent challenges companies face while trying to redesign their business model. Our results point out that being able to accumulate and put into action external ideas can be vital in supplementing internal knowledge base and therefore crucial in escaping technological lock-ins; thus, imposing efforts toward digital transformation offers favorable outcoes.

Keywords: Innovation; digitalization; SME

JEL Classification: D20, O31, O32

1. Introduction

Increased competitive pressures on international and domestic markets lead to rapid alterations of value chains through digitalization of processes, making it leading agent of change affecting the present industrial system. Therefore, rethinking business models and especially the implementation of cyber-physical systems along the value chain is at the forefront of academic research [Chesbrough (2010); Nielsen *et al.* (2018)], usually identified as Industry 4.0 [Lasi *et al.* (2014)].

*Corresponding author.

The upsurge of digital technology has overpowering implications on competitive positioning, firm's value chains and overall business model. Value creation facilitated by emerging digital technologies alters costs (efficiency), as well as process performance. The development of new business models can be approached threefold, i.e. service-oriented, network-oriented and user-driven. First, service-oriented approach is related to the change from product to service mindset [Fleisch *et al.* (2015)]. Secondly, network-oriented approach scrutinizes changes in business models toward value distribution and joint value creation by constant interactions between actors [Wirtz *et al.* (2016)]. Thirdly, user-driven business model relies on the capabilities of the firm to learn from the customers [Ehret and Wirtz (2017)]. Furthermore, digital transformation can be classified depending on the degree of innovation and the impact on the business model, that is: (1) internal and external process optimization, (2) consumer interface improvement, (3) new ecosystems and value networks and (4) new value products-smart product and service [Nielsen *et al.* (2018); Osterwalder and Pigneur (2013)].

Small- and medium-sized enterprises (SMEs) have been leading digital transformation and innovation processes, either in an emerging form as start-ups/spin-offs or as established firms. Most of prior research is centered around the efficiency argument in addition to innovation performance of SMEs [Hossain (2015)]; however, implementing innovation and mechanisms for proper modulation are still deficient [Li *et al.* (2008)]; Love and Roper [2015]; West and Bogers (2017)]. While shifting toward increased innovative fundamentals in order to grasp new business opportunities, business models absorb new strategic objectives changing the overall strategy toward networking, learning and leveraging complementary resources [Brunswicker and Vanhaverbeke (2015); Grandi and Grimaldi (2003); Sanchez and Mahoney (1996)].

Integration of knowledge, technologies and networking partners requires new mechanisms that can be imposed exogenously or, if possible, endogenously through upgrade of firm's own capabilities and management, which leads to creation of new value. Indeed, in this process, SMEs encounter difficulties and risks that oscillate value creation and appropriation opportunities. Hence, some aspects of running tight innovative operation or trying to become one are predominantly related to the perils of imposing new and innovative technologies to reduce cost errors (thus, rise efficiency) and increase process performance.

The research question is targeting the innovation aspects of digitalization while trying to redesign the business model. That is, being able to accumulate and put into action external ideas can be vital in supplementing internal knowledge base and therefore crucial in escaping technological lock-ins, thus imposing efforts toward digital transformation offers favorable outcomes. For this purpose, we use three basic dimensions, i.e. types of innovation actions, process perspective and sectoral systems of innovation, by employing a convenience sampling approach.

Due to field research and in-depth interviews with owners and managers of SMEs in North-East Italy area, we combine and analyze evidence of the contingent challenges these companies face while trying to redesign their business model toward the innovative digital era.

This paper is organized as follows. In the next section, we present a condensed literature review and elaborate the main objectives. We use separate section to build the lines of research, followed by the research methodology of the study where we explain the model. There is a specific section analysis and discussion of the results where we convey our findings, linking the evidence to theoretical underpinnings. The paper ends with conclusions and suggestions for future research.

2. Literature Review

The multidimensional nature of innovation in SMEs, which is determined, both by variety of practices and types of implementation, has been examined extensively by quantitative (empirical), as well as qualitative (case study) literature. Further, the narrative is still not settled on the issue of innovation problem-solving [Felin and Zenger (2014)], because multiple search directions and knowledge domains shape firm's strategies, thus the dynamics and implementation of innovative features are much context-dependent. In consequence, opportunities and/or risks emerge while innovation mechanisms are imposed, and most often than not, they cannot be analyzed outside the contextual framework [Edwards *et al.* (2005)].

This study uses three research lines, along which a qualitative analysis is centered. Further, each section of this study is strongly reliant on the particular features of each case study selected for scrutiny; thus, having fixed aggregators helps to draw essential and needed conclusions. First, some *types of innovation actions* are typical for SMEs and usually dependent on knowledge sourcing models, in which collaborative innovation is perused [Vossen (1998)]. Secondly, the *process perspective* allows SMEs to use the most of the technology under development, where realignment of the business model to innovation strategy is necessary [Chesbrough (2006)], in order to rip benefits from knowledge networks (academia, research partners, external networks, etc.) [Julien (1995)]. Thirdly, *sectoral system of innovation* is predetermining the dynamics of innovation of small companies, that is, proximity to new knowledge and competitive pressures to undertake/invest-in specific innovation strategy [Malerba (2002)]. Motivated managers can make change; reducing the "agency problem" (separating management and ownership) is advised in order to reshape the business model and thus increase modularity and value creation.

Internal failures to adopt a certain business model and innovation strategy are most often linked to bureaucracy, costs of intellectual property appropriation, legal actions, cognitive reasons as well as organizational challenges [Parente and Prescott (1994); van de Vrande *et al.* (2009)]. Inadequate managerial capabilities to integrate relevant external knowledge, inexperience and lack of a strategic vision are some of the reasons that can harm adoption of certain technology and tailor fitting firm-specific strategy. Further, inaccurate targeting could cause information asymmetries and communication problems that generate intrafirm alliances and increase opportunistic behavior. In this regard, it is evident that risks may precipitate a variable firm performance outcome [Belderbos *et al.* (2004); Birley and Westhead (1990); Cai and Szeidl (2017)].

As far as external risks are concerned, some of the most prominent that harm the implementation of innovation in SMEs are ineffective legal protection, knowledge gaps, information asymmetries among partners as well as unbalanced market power and knowledge leakage [Apostolov (2016); Brunswicker and Vanhaverbeke (2015); Felin and Zenger (2014); Foster and Rosenzweig (2010)]. High-technology research and development are strategic assets of SMEs and very much dependent on the way firms cooperate, thus it can be a benefit or a hurdle [Oakey (2013)].

It is understandable that firms will try to target benefits rather than account for the risks when imposing certain innovative strategy and business model. However, unpredicted costs and process performance problems will arise within specific, case-based contexts, which undermine or bolster the effective implementation.

I. Types of innovation actions

Integrating external knowledge through sets of innovation activities is the essence of business strategies. Further, there are two basic types of innovation actions, that is, inbound and outbound innovation actions [Dahlander and Gann (2010); Enkel *et al.* (2009); Greco *et al.* (2015)]. Concerning the first one, some of the main forms that are most suitable for small- and medium-sized companies can be customer and user involvement (for example, CRM), intellectual property licensing and research and development alliances (either with universities/research centers or clusters of firms). On the contrary, outbound innovation actions are considered to be more advanced, thus, some of the more prominent ones are technology-selling, co-development with customers and clients external technology development.

Alliances and external networking are the most common ways to acquire innovation assets and new knowledge, while customer and user involvement can be exercised to exploit external technology in a useful manner in order to increase innovation and competitiveness. Empirical work has also suggested that SMEs are keen on undertaking external technological collaborations as a base for upgrade of their process performance [Nieto and Rodríguez (2011); Nieto and Santamaría (2010); Parida *et al.* (2012)].

External technology development proves to be more problematic for SMEs mostly due to lack of resources (assets or knowledge). Hence, as their innovation position suffers from critical knowledge deficit, inter-firm alliances and competition on end markets further undermine their innovation capability [Ritala *et al.* (2015)]. Indeed, if SMEs are to peruse outbound innovation actions they are usually conditioned by comprehensive development of appropriation mechanisms [Di Minin and Faems (2013); Leiponen and Byma (2009); Spithoven and Teirlinck (2015)].

II. The process perspective

Remodeling decision-making modes and overall process reengineering is needed for digital transformation. Realignment of the business model to the innovation strategy enables utilization of emerging technologies [Chesbrough (2006, 2010)]. Henceforth, organizational design is crucial concern of strategic decision-making process. There are few contextual variables that need to be taken under consideration when trying to (first) comprehend and (second) impose a specific

organizational design, and these are related to size, business environment and technology. Further, organizational design is also closely bound to structural change, which, if considered in a more dynamic perspective, will provide concrete notions of possible ways to change. Following this thread of thought, the literature on organizational design provides basis for either design "archetypes" [Miles *et al.* (1978)] or "configurations". [Mintzberg (1989)]. In contrast, design can be used for "transitions" of organizations and/or their "transformation" [Bridges (1986)]. Organizational design change that shapes organizational structures is dependent on shifting contingencies and paradigms, as well as managerial interpretations or decisions as to shape the scope of the structural change [Tosi and Slocum (1984)]. Many firms and especially medium and small enterprises that try to increase presence on the market view business process reengineering, reduced system redundancy and improved organizational flexibility as important drivers for taking final decision and digitalizing their business [Bell and Loane (2010); Mathrani *et al.* (2013); Zaridis and Mousiolis (2014)].

Business process reengineering and appropriation of new digital business models enable SMEs to seize the benefits from knowledge networks (academia, research partners, external networks, etc.) [Julien (1995)]. Firms usually employ a learning process on three separate knowledge domains [Li *et al.* (2008)]. The first domain is scientific knowledge, which enables enterprises to understand their own research and development potential and embark on contemplating innovative processes. Secondly, technological knowledge appropriation is tied to search and learning about new technologies (digitalization), how to impose/modify learned technology and how to exploit product knowledge. Thirdly, product or market knowledge is used toward learning the demand, its absorptive capacity for the new products/services and innovative value chain. Taking the proper exploration path proves to be critical and highly dependent on managerial knowledge and capabilities. Certainly, a variety of managerial competences are needed for positive outcome of business process reengineering, partnerships, enhanced cooperation and communication [Belderbos *et al.* (2004); Cabrera and Cabrera (2002); Dahl and Pedersen (2004); Du *et al.* (2014); Muller and Peres (2019); Ritala *et al.* (2015); Spithoven and Teirlinck (2015)].

III. Sectoral systems of innovation

Integrated view for the concept of sectoral systems of innovation takes under consideration the range of products that are created and sold by a set of agents. Furthermore, sectoral systems of innovation have specific knowledge base, technologies, inputs and demand. Interactions between actors is shaped by institutions and over time the system is in perpetual transformation, dependent on the actions of agents [Malerba (2002); Pavitt *et al.* (1989)] Innovation sources, appropriability regimes and technological opportunities define sectoral systems of innovation.

SMEs differentiate themselves within a system owing to the dynamics of innovation implementation (especially when it comes to emerging technologies). Knowledge exchange and technological collaboration can be tied to sectoral patterns of innovation [Castellacci (2008)], and in fact SMEs are dominant within few

categories, of which most prominent are science-oriented, supplier-centered/specialized supplier and information intensive. First, science-oriented small- and medium-sized firms utilize markets as a main source of new value creation by exploitation of advances in scientific knowledge [Cardinal *et al.* (2001); Love and Roper (2015)]. Secondly, supplier-centered/specialized supplier incorporates two dimensions, i.e. influx of knowledge from supplier and being a specialized supplier. In the case of exogenous influx of knowledge from supplier, innovation comes in the form of new components, materials or equipment where learning by doing or exploitation of external knowledge is sort of push toward innovation. Whereas being a specialized supplier means that innovation has to come in form of customization by improving performance, reliability, etc., where product-market knowledge is essential [Wagner (2012)]. Thirdly, the information-intensive sectoral system is related to knowledge base and practices within information and communications technology (ICT) paradigm in which value creation comes from consumers or suppliers, as well as multi-technology upgrade of processes [Dibrell *et al.* (2008)].

3. Research Methodology

Convenience sampling is a specific type of non-probability sampling method that relies on data collection from population members who are conveniently available to participate in the study. Due to the specific nature of the study, that is, willingness to disclose information, industry contacts, etc., the research had to apply a convenience sampling approach [Lavrakas (2008)]. Data were anonymized for the purpose of protecting company's private activities while maintaining the integrity of the data gathered and shared.

3.1. *Survey*

The data rely on questionnaires prepared and evaluated by a leading univeristy in Italy in scope of the project "Strategic entrepreneurship and strategic renewal in small-and medium-sized enterprises in mature industries" with La Camera di Commercio. The Chamber of Commerce creates the project PID — Punti Impresa Digitale, a network which aims to bring new service facilities dedicated to dissemination of digital technology to MSME (micro small medium enterprises) in different economic sectors. It is a network of "physical" points as well as "virtual" network using a wide range of digital tools: specialized sites, forums and communities, use of social media. The leading universitiy has been tasked with PID assistance service accompanied by training, mentoring and open innovation initiatives envisaged by the program. Hence, the main involvement of the University is to analyze the technological standing of local businesses; develop training programs and practical workshops on the application of digital technologies; launch pilot projects in individual companies with the support of young entrepreneurs and set up an observatory on digital transformation in the northeast of Italy.

Further, based on the willingness to disclose information even if anonymized, the research had to apply a convenience sampling approach, thus we have chosen eight

companies that were most willing to reply, from a larger collection being analyzed by the project (Table 1).

3.2. *Case studies and classification of SMEs*

In order to reconcile different innovation contexts with the related challenges, multiple case analysis is used in this research based on data gathered by in-depth interviews with key representatives of eight firms present in the survey. The business model and especially the company strategy significantly influence benefits from innovation; however, they also predetermine difficulties in the same manner [Chesbrough (2010); Miles *et al.* (1978); Sanchez and Mahoney (1996); Wirtz *et al.* (2016); Zott and Amit (2007)]. Due to contextual diversity of the companies in the sample (Table 1), the selection follows aggregate research lines in order to maximize output from this study. Therefore, by selecting the firms that are willing to provide data and explain in detail their capacities, purposely providing in-depth information on present and future digitalization ventures, we have made an effort to increase the efficiency and output of this study [Yin (2009)].

Collecting empirical information on innovation and digitization at firm level allows possibilities for close comparison and classification of analyzed cases [Du *et al.* (2014)]. By combining information on each individual case study participant in the project, we have managed to assemble three main lines of research: type of innovation actions, process perspective and sectoral systems of innovation. The first two lines of research define internal context and innovation capacities of the case studies in question, whereas the third line of research alternates the external context because

Table 1. Characteristics of companies in the sample.

Company	Sector*	Average turnover 3 years in	Number of employees	Selfi 4.0**
ELEVATOR	(73.11) Mechanical maintenance company	1,483,000.00	10	N/A
SHIP	(74.10.30) Technical engineering and design (shipbuilding)	1,585,000.00	24	Yes
BODY SHOP	(45.20.2) Repairing/renting/leasing automobiles	950,000.00	13	Yes
BUS	(79.11) Online travel agency	350,000.00	8	Yes
FOUNTAIN	(81.21.00) Fountains, pest control, gardening	703,740.00	18	Yes
PLASTIC	(22.21.00) Manufacturing of plastic tubes and profiles	15,500,000.00	52	Yes
AGENCY	(73.11) Advertising and promotion activities	306,846.00	7	Yes
TIRE	(28.99.2) Manufacturing of industrial robots and parts	5,000,000.00	40	Yes

*Classification of economic activities ATECO (2007) adopted by the Italian National Statistical Institute (ISTAT) for national economic statistical surveys.
**SELFI 4.0 — Self-assessment-online questionnaire, part of Digital Business Points (PID) of Camera di Commercio.

small- and medium-sized companies are quite susceptible to their environment, especially taken under consideration the precarious characteristics of innovation [Edwards *et al.* (2005); Hossain (2015)].

4. Case Studies

4.1. *ELEVATOR*

The company ELEVATOR (anonymized) is a mechanical maintenance company that does repair and periodic checks of elevating work platforms in the Noth-Est Italy area. In 2015, it has acquired, a stairway-moving brand, with the necessary industrial know-how, which allows a strategic objective to be accomplished, i.e. the traditional service activity is accompanied by a new industrial construction and assembly activity. The commercial activities are initially aimed at the Italian market, servicing the network of authorized workshops, at present 18 in all Italian regions, and support after-sales and general assistance. There is further expansion of commercial actions for the markets of France, Spain and Malta, especially with new models. In addition to the production of the main product, ELEVATOR also deals with truck-mounted work platforms. Further, ELEVATOR is Certified Training Center EC051/FESICA, and starting from 2019, it has introduced a new product, an vertical self-propelled platform, throughout the national territory, owing to a commercial structure able to cover the whole peninsula.

The business model mainly addresses two categories of customers, which are rental companies and end customers. Operational capacities of the firm include maintaining extensive network of service workshops in Italy; rapid response by suppling spare parts to service workshops in 24–48 h and replacement vehicle in case of downtime in the workshop; constant improvement of working conditions (such as loans in the South, INAIL (insurance against accidents), training courses, etc.); client consultancy for financial instruments (leasing, operating lease, long-term lease, etc.). Digital transformation activities start by structured web site. Strategic processes in the firm are supported by TeamSystem ERP (Enterprise Resource Planning), which provides all the tools necessary for a complete and effective management of activities (sales, purchases, production, warehouse, accounting, etc.), allowing correlation and revision of the necessary supporting information for decision-making and executive functions. In addition, there is a move toward more structured CRM (Customer Relationship Management) system as the present R&D division of the firm independently develops solutions for digitalization.

Further plans toward innovative activities and especially digitalization of core processes within the company include learning and training for cloud and big data; investment in numerical control machines is still under evaluation, as the target territory does not have aluminum carpentry culture, which they do internally; obtaining the exclusive right from a major Power Supplier to avoid noise and pollution and to increase energy saving (alternatively, it would be of strategic interest to the firm to register its own patent); in-house development of a "Machine Learning Project" applied to predictive maintenance and its wear and CRM shifting toward

Social Media Engagement and increase in capacities of the R&D division in the development of a predictive maintenance and preventing physical failures.

4.2. *SHIP*

SHIP (ananoymized) is a naval industrial engineering and design studio established from employees of Breda/Fincantieri (Shipbuilding Company). The growth of the firm has always been constant, entered into Nord Est Engineering Consortium supported by Fincantieri with five other companies to provide the customer with a complete order, where SHIP is tasked with plant projects and about 50% of its total turnover is derived from new orders from the Consortium.

Among the various projects that have been carried out by the firm, it is necessary to mention the first *gas* propulsion ferry built in Italy, a clear example of the company's constant investment in R&D and of the strategic vision aimed at seizing the new market opportunities making it a break-through in field of environmental shipbuilding sustainability. In fact, as of 2020, it will not be possible to use marine fuels with more than 0.5% sulfur, which certainly means a transformation of the navigation world, dubbed as GNL (liquefied natural gas — LNG), an innovative sector where the company has leading foothold. On the one hand, the studio specializes in this type of marine propulsion systems, and on the other hand, the firm is committed to a five-year contract with Fincantieri. As far as the relationship with digital and innovative technology goes, the studio aims at virtual reality presentations of their designs and engineering capacities to consumers. Virtual reality is crucial for visual previewing of the machines together with the clutter of pipes, how the machines work, the complexity in the optimization of space and the co-design of the ship structure.

As this company's innovation is driven by strong contracts with a specific consumer, which makes it specialized supplier, further digitalization will structure some of production and customization processes through increased capacity with naval engineers; financing patents, especially in relation to the systems linked to gas and dual fuel engines; investments in network security system and data management of sensitive information (project piloted by Fincantieri) and invest in virtual reality projects that have already been widely appreciated by customers and hence there is a need to find a solution, a logarithm, which allows 3D models of machines and construction details to be obtained.

4.3. *BODY SHOP*

The company has a long history and succession of owners, whereas the current legal form was registered in 1999. BODY SHOP (anonymized) has been present in its current location since 1993 and is still partly using technologies from that period even though much has been upgraded toward mechatronic diagnostics. In the 1990s, it entered the business of renting company fleets, to complement the body shop and tire shop, with FIAT parent company, which they have now abandoned and are in partnership with RENAULT/DACIA having the role of a broker.

Their service is essentially a B2B service, an area that offers greater margins and greater growth. BODY SHOP utilizes relation with an insurance company (with CarServer) and a bank to supply rental cars to private individuals (through installments, insurance, maintenance for 24 months, etc.). Throughout the years, the firm has invested intensively in their innovative capacities and digital transformation. These include: appropriation of a billing software that manages repair end-to-end processes; another software which makes easier to track number of hours worked on each car and especially download the technical data sheets of each car to make the disassembly work easier; Electronic Measuring System Touch a complete hardware and software that detects the presence of problems with the car; spectrometers for color and OBD, an on-board diagnostics standard. In addition, the company has to use different management systems specific to parent/client companies for easier data interchange.

Being supplier-centered company brings stability to the present business model; however, efficiency falls behind due to lack of investments in innovative and digital upgrade of core business processes. Therefore, further actions in this regard would mean: finding a solution for assigning working hours to a specific machine (currently employees must access the centralized computer to assign their hours to a specific machine); developing an application that shares timely information of the state of repair work to end consumers (the concept is to add information as things progress and reach the user with a direct messaging, for example, request authorization to proceed with the installation of a spare part); automating the management of working hours by developing a mobile system that allows association of the maintenance to an employee; interaction of the existing software with Android smartphones connected to the network; database useful for internal statistics regarding spare parts on stock, i.e. inventory spare parts management and investment in equipment and maintenance.

4.4. *BUS*

BUS (Anonymized) is the mobility company that offers bus connections from over 250 locations to the most important events and entertainment venues in four countries: Italy, Austria, Slovenia and Croatia. It is an innovative start-up registered in 2015 by a group of professionals from the transport, tourism and communication sectors. The idea of opening this business was based on the lack of offer to reach specific events, the lack of integration between event organizers and transport organizers as well as the use of obsolete and often complex payment methods.

The company offers connections to over 250 locations for: the major sporting events; the main fairs on the national territory; the most anticipated concerts in Italy, theme days at the amusement park. The business model is as simple as it is effective, i.e. the firm sells a place on the bus (not owned) by grouping people to stake to major events with an average of 2.5 passengers per transaction. The purchase can be made through their website, which refers them to the Amazon platform, or to more then 2000 points of sale in Italy and abroad (travel agencies, ticketing, newsagents, ticket vendors, etc.). The marketing also consists of partnership with

companies in the sector of environmental awareness and transparent reviewing of the service. The company is still using start-up funds for major investments such as crowdfundings, Regional, Nationals and interantional call for founds. Given the success achieved with BUS, the company has created a spin-off a new online platform in the parking sector for management and booking of parking spaces at the major events. New and innovative concepts have been introduced as a backbone of this company. Many of the investment is directed toward an IT business model in which the use of website, social networking and especially the Amazon platform make the core of the business. The company is still lagging on integrated CRM system; however, the firm manages to compensate by using predictive analysis with algorithm that estimates passengers to be transported and book the necessary buses (the analysis is carried out on the data based on sales). Business Intelligence User Interface is used, and artificial intelligence (AI) is embodied into the home-site by parameters that decide the best experience for the user. Robust investments in innovation already include around 600 thousand euros in 2018, and in the forecast for 2019, it includes an allocation of almost 1.5 Ml euros.

This is a company explicitly using market knowledge and the business model is information-intensive, with a possibility of dynamic outlook. Their innovative strategy involves further digitization and automation of core business processes, and some of the bold plans to increase lucratively involves: increase in Research and Development to allow higher degree of marketing automation and acquire adequate know-how for CRM management and populate CRM better through Social Listening; perfecting the Business Intelligence User Interface and tying it to the CRM and AI of the website (by using mailup and mailchimp), hence all systems and platforms must be connected and data must be given a meaning; implement a predictive mathematical model that simulates the number of customers interested in an event, the necessary transportation routes and prices; automate the process of selling empty seats of tour operators on non-BUS journeys (through affiliated sales points) and improve the user experience and interact with some mapping system to allow a geo-reference of the BUS stops, hence finding a solution that best integrates all the components.

4.5. *FOUNTAINS (anonymized)*

It is a multiservice company which designs, creates and decorates all types of outdoor spaces. Today the company is divided into three brands: "Forme di acqua" (fountains), "Pest Control" (for pest control) and "E-gardening" (design, construction and care of gardens and green spaces with design elements, home automation and lighting), almost exclusively function as B2B company.

The innovation efforts revolve around their three subdivisions. First, from an organizational and process point of view, the company moves toward unified customer relationship management of the three brands through user-friendly CRM platform also available on smartphones. Due to rapid growth of all three subdivisions, there is a need for constant modification of the CRM with more customization options. Secondly, initiative into virtual reality for the subdivision "Forme di acqua"

(fountains) as a way of presenting the projects (especially at international fairs) to reduce the costs of promotion and increase the added value to the corporate image. However, this is still out of reach due to investment capability restrictions. Thirdly, as far as the subdivision of "Pest Control" is concerned their attention is toward the use of sensors to monitor insect baits present in the areas supervised by the company and also to allow customers to check the status and function of the device. This would allow visibility (disinfestation tends to be invisible in the eyes of the customers) and therefore strengthen the relationship of trust and loyalty.

This firm tries to overcome low-tech path dependence as a specialized supplier to known sectoral customers and further customization by expanding its market knowledge. There are two main efforts toward improving innovative capacities. First, there is significant effort toward unification of the management systems and increase of specialist knowledge for the use of the CRM (at present is used by three people, while there are five licenses). Secondly, there is planned implementation of activities monitoring system related to the devices for pest control, notably: digital monitoring (via mobile phone or computer) of the activities (which would allow to have a greater knowledge of processes, increase in communication quality and visibility of services) and allow customers and anyone who frequent the spaces subject to treatment to obtain data on pest control activities in progress and cyclical monitoring (bait change).

4.6. *PLASTIC*

PLASTIC(anonymized) has been operating since 1961 in the production of PVC/polyethylene pipes, fittings and ducts for industrial use and construction of water supply, wastewater discharge plants and construction of agriculture irrigation systems. The company functions in a mature sector; however, it makes efforts to adopt Industry 4.0 paradigm through investments of around 400 thousand euros just for 4.0 digitalization. Located in a market with low profit margins, their competitiveness strategy is based on two factors: (1) capacity to increase productivity by optimization of production processes (here automation and management of raw materials come into play, as well as better monitoring of production costs in various production processes, especially the customized ones) and (2) customer orientation, customized orders and innovating the aesthetics of the product.

In 2008, PLASTIC acquired FIRM A (anonymized) and transformed it into a branch dedicated to the production of PVC fittings (standard or customized), thermoplastic processing by injection molding (thermoforming). As of 2014, the firm acquired FIRM B (anonymized), in order to enter the production of PVC and polyethylene pipes by combining steel and carbon, useful for the construction of water wells, drainages and environmental spaces. Digitization helps manage the integration between the acquired company branches. The interest toward the innovative digital technologies has taken into account two aspects: optimization internal management and better CRM. However, the priority is on automation and digital monitoring of production phases, i.e. the machinery communicates bi-dimensionally (demand and answer). There is already fiber optic in all production

lines. Since 2012, new digital machines have been put into action together with a specialized system for communication and remote diagnostics. The automation of production processes, thus elimination of operator handling, is paramount and expected in the next phases of coexistence between various production systems.

PLASTIC is diversified specialized supplier in a mature industry that relies on versatile technical knowledge, and this company uses fair degree of scientific knowledge, specifically chemical and thermoplastic. Anyhow, due to competitive pressures and low margins in its sector, it is forced to increase market knowledge and customization, especially for international markets. There is considerable need to transition to 4.0 factory. Hence, PLASTIC aims at a certification of 4.0 company as investments are already underway. There are several aspects crucially important for the firm: training of the personnel to make the transition toward digital innovative 4.0 factory; digitization of warehouses with the possibility of controlling movements of the forklifts by barcodes for materials on stock and sensors; update of digital security and overall integration of all production branches.

4.7. *AGENCY*

AGENCY(anonymized) is a marketing and communication agency that employs innovative and digital methods to increase market share. Their business strategy is directed toward products such as website design, which is marketed as a virtual business card to increase client's marketing potential. In addition, another product is design of online marketing strategy and channels of promotion such as social media profiles, e-mail lists and contacts. This also entails a "search and find" package or an advertising campaign through Google, Facebook, Instagram, Linkedin and other channels. Furthermore, the company designs traditional products in form of flyers, brochures, catalogs, posters and other offline communication materials. Part of their business model is also overall design and setup of a store, interior and exterior wall decoration, related to brand creation and management.

Being a marketing and communication company means a move toward 4.0 business model; thus the firm strategy is shifting toward the use of the advanced digital tools to offer all-round marketing services to their customers: from the editorial plan and branding, to e-commerce management supported by CRM and data analysis. Nonetheless, at this point, they are still struggling with visibility and pushing the regional market to seize opportunities by digital presentation, which makes them pioneers in their geographical proximity. Communicating the value of their offer to consumers becomes a challenge; however, creating distinctive foothold on the market is to bring diversified consumers. Hence, a diversification strategy tied to innovative and digital 4.0 business model is under way to make a significant social impact. The firm has already incorporated some aspects and moved toward reshaping their business; thus the firm acquired some necessary skills by participating in trainings and workshops. In this process, they are targeting increase of knowledge related to artificial intelligence, big data analysis and social media marketing.

There is good level of inbound innovation actions with tendency to branch off toward some outbound innovative actions. The company levitates between technological and market knowledge and position between specialized supplier and information-intensive category in the spectrum of sectoral systems of innovation. Hence, from a process point of view, there is a strong need to find an equilibrium in intrafirm dynamic and balance between owners in order to best utilize their diverse knowledge while restructuring the business model. Furthermore, the company needs acquisition of skills for data analysis, management of online marketing, social media and e-commerce as it moves toward market-driven business model.

4.8. *TIRE*

TIRE (anonymized) was created in 1984. Vesta is mainly engaged in the production and sale with its own brand of pneumatic components for industrial automation (range of solutions and devices operated by compressed air for industrial machines). The standardized production is worth 70% of their turnover, while the remainder of the production is customized. Hence, they focus on standardized products to increase market presence, especially at the international level.

The production processes are equipped with high-technology tools and CNC machines; however, operators carry out some tasks (for example, assembly) on special benches. Technological innovation at the production level has a gradual transition between mechanical and digitalized production. The coordination between production phases and in the supply chain is not yet completely digitalized, but business plans confirm push toward next level. The company is ISO 2001-certified for management control. There is also a vertical warehouse managed with digital tracking tools and automated retrieval of the pieces. Large companies, even multinationals, dominate their reference market, while there are also smaller companies present in the sector. The company is equipped with ERP and CRM, which are not used by commercial customers because of various obstacles that the company aims to reduce.

TIRE might be the brightest example of this set of companies that score high on almost all criteria of innovation in this study. Even though there is a good measure on inbound innovation activities, the basis of its business model is built or tends to revolve around outbound innovation activities (co-development, external technology development, technology selling, etc.). Secondly, from a process perspective, this company is well situated between scientific and technological knowledge and however lacks critical market knowledge (because of the particularities of reference markets where it is most present) in order to improve customization. Therefore, a priority is assigned to two aspects that concern the relationship between the company and the outside, i.e. E-commerce (B2B) and CRM. The digital innovation strategy targets expansion of company's presence on foreign markets. Customer management is of particular strategic importance, while the sector is dominated by strong and stable relationships between suppliers-producers-customers due to high entry/exit costs and barriers to enter into the market; thus, new potential customers are of primary importance. Henceforth, the implementation of an integrated system

comprised of both CRM and e-commerce (B2B) (eventually tied to a mobile application) for the standardized product line is more than necessary.

5. Discussion

This study is comprised of three main lines of research: type of innovation actions, process perspective and sectoral systems of innovation (Table 2). The first two lines of research define internal context and innovation capacities of the case studies in question, whereas the third line of research examines the external context.

5.1. *The internal context and low-tech paths*

Knowledge sourcing models are typical for SMEs where collaborative innovation is perused. Innovation activities are determined by the internal context and the capacities of the firm, and successful implementation of innovation is reliant on external technological inputs. Acquiring and integrating knowledge in firms that might be on low-tech paths will be shaped by the managerial capacities of the firm. Business strategies of the SMEs incorporate external knowledge either through inbound (customer and user involvement, intellectual property licensing, research and development alliances, etc.) or outbound actions (technology selling, co-development, external technology development, etc.) (Fig. 1).

The implementation of inbound innovative actions means exploitative learning of digitalization and its innovative potential for reforming internal capabilities [Enkel *et al.* (2009)], especially for firms on low-tech paths. Hence, the next step is establishing strategic alliances to increase influx of knowledge in order to extend product innovation to new markets [Apostolov and Scagnelli (2019); Cesaroni *et al.* (2005)].

In contrast, successful sourcing strategies can lead to implementation of innovation, especially in cases of supplier dominated sectors. Nonetheless, such instances are challenging because of business model rigidness due to formalization practices imposed by supplier. Therefore, engaging in collaborative ventures may restrain the internal knowledge base and thus further harm innovation dynamics. Developing a business model around domination means acquiring specific technological knowledge, which eventually leads to standstill of possible new outcomes. Imposed or excessive formalization can be reduced by a new product/process placement, but that also means original knowledge, which is difficult to capture especially for small- and medium-sized companies that lack resources.

Most of the companies in this sample are SMEs that gravitate toward a low-tech path; however they have many reasons and are willing to overcome structural

Table 2. The analytical model comprised of three lines of research.

Type of innovation actions		*The process perspective*			*Sectoral systems of innovation*			
Inbound	Outbound	Scientific knowledge	Technological knowledge	Market knowledge	Science-based	Supplier-centered	Specialized supplier	Information-intensive

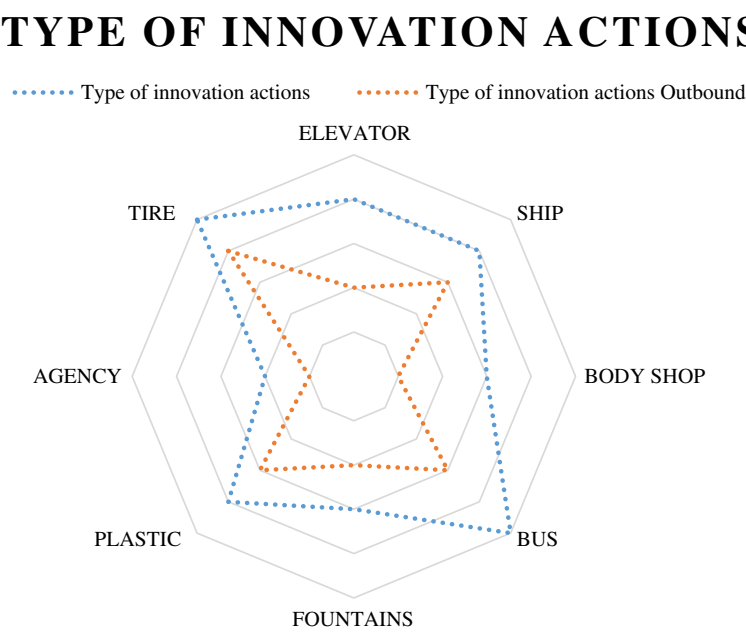

Fig. 1. Type of innovation actions — The internal context and low-tech paths.

Table 3. Matrix on type of innovation actions.

	ELEVATOR	SHIP	BODY SHOP	BUS	FOUNTAINS	PLASTIC	AGENCY	TIRE
Inbound	X	X	X		X		X	
Outbound				X		X		X

X represents importance in the business model.

difficulties in their processes and reshape business models especially through digital transformation. There are cases that are dependent on inbound innovation actions, such as BUS, a company pushing toward greater innovative activities in order to capture market. Slight exception from this sample is PLASTIC that leans toward outbound innovation actions and hence could be a business model worth considering a replication.

5.2. *Knowledge*

Understanding internal capacities and processes allows better use of the knowledge at hand, as well as improving innovative potential through digitalization and realignment of the business model to innovation strategy. This also means using the benefits offered by certain types of knowledge networks (academia, research partners, external networks, etc.) [Chesbrough (2006); Julien (1995); Scagnelli *et al.* (2019)]. The process perspective analyzes firm processes in light of different types of knowledge. Thus, three knowledge categories are significant in this regard, i.e.

scientific, technological and market knowledge. Scientific knowledge is essential for firms as it enables in-house research and development, which is the backbone of new and innovative processes, empowering firm's own capacities [Arora and Gambardella (1994)]. Imposing new technologies goes through a process of knowledge appropriation, which includes elements of learning, modulating and exploiting acquired knowledge [Howells *et al.* (2003)]. Pioneering market-based supply chain and knowing the target market and demand for new products are the necessary market knowledge that SMEs must secure, especially those operating in poor ecosystems [De Luca and Atuahene-Gima (2007)](Fig. 2).

Bringing science to the market is an innovation path most lucrative because it enables advances in research and development to reach market premium rates, a consequence of overall novelty and functionality. On the contrary, technological knowledge-based business models most often target the industrial sector, whereas market knowledge is related to final/end use and consumers. Innovation strategies shape business models toward transitioning from science and technological to perusing market knowledge as endgame scenario. Nonetheless, incorporating technological and especially scientific knowledge can put companies in peril because of complexity, novelty and preparedness of absorption. Integration of external knowledge increases appropriability and managerial convolutions.

It is evident that technological knowledge is dominant in this sample of SMEs. SHIP and PLASTIC are examples that best describe the process perspective related to application of technological knowledge, whereas ELEVATOR, BODY SHOP and FOUNTAINS levitate between technological and market knowledge. TIRE has good position to use technological and scientific knowledge in order to move more aggressively toward new market segments. In contrast, AGENCY has lack of focus, even though it tends to increase market knowledge. A company that utilizes most of

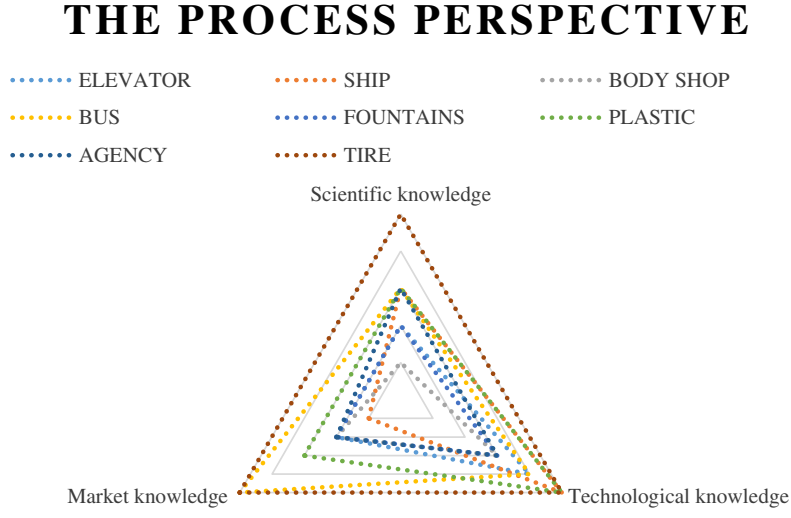

Fig. 2. The process perspective — It is all about (thy) knowledge.

Table 4. Matrix on the process perspective.

	ELEVATOR	SHIP	BODY SHOP	BUS	FOUNTAINS	PLASTIC	AGENCY	TIRE
Scientific knowledge								X
Technological knowledge	X	X	X	X	X	X		X
Market knowledge		X		X		X	X	X

X represents importance in the business model.

the digitalization tools to scale the market is BUS, a business model that is still unsettled; however, it has the decent potential to craft new ways.

5.3. *External push or pull*

The sectoral systems of innovation determine the dynamics of innovation [Malerba (2002)]. Reshaping business model is reliant on managerial capacities of the firm, and the proximity to new knowledge influences innovation strategy. This study uses three (or four, subject to different literatures) sectoral systems of innovation, that is, science-based, supplier (in this regard we split this sector in two, i.e. supplier-centered and specialized supplier) and information-intensive. Science-based SMEs exploit advances in scientific knowledge and research & development trying to gain foothold on new markets [Cardinal *et al.* (2001)]. It is not unusual that SMEs revolve around supplier/s, where in most cases they get certain knowledge push from specific suppliers because of formalization of practices in the dominant (supplier) company. Being a specialized supplier relies on customization of products for number of customers (for example, cooperation is determined by standardized procedures/products required by consumer) [Wagner (2012)]. Information-intensive companies utilize multiway knowledge of information and communication technologies; their value creation can come from any part of the value chain (from suppliers to consumers) [Dibrell *et al.* (2008)] (Fig. 3).

Application-oriented innovative solutions are dominant in the cases of supplier-centered and specialized supplier options. These sectors are quite dependent on either the supply-side (supplier-centered) or demand-side (specialized supplier) technological inputs/outputs, thus, the focus is mostly on reliability, customization and performance improvement [Forsman (2011)]. Such orientation can cause lack of resources invested in new innovative searches, contingent on the cooperation with the supplier/customer. In contrast, external technology co-development (mainly in the case of B2B cooperation) can spark innovation because firms are pulled toward engineering and patenting [Kaufman *et al.* (2000)].

Synchronization of internal and external resources becomes more complex; operational and coordination costs increase as firms increase innovation activities. Indeed, it is a challenge for managers to achieve the right balance between sourcing and control. With the upsurge of information and communications technologies, companies are inevitably pushed toward paths they cannot understand or control, and business models are increasingly dependent on network effects in order to stay

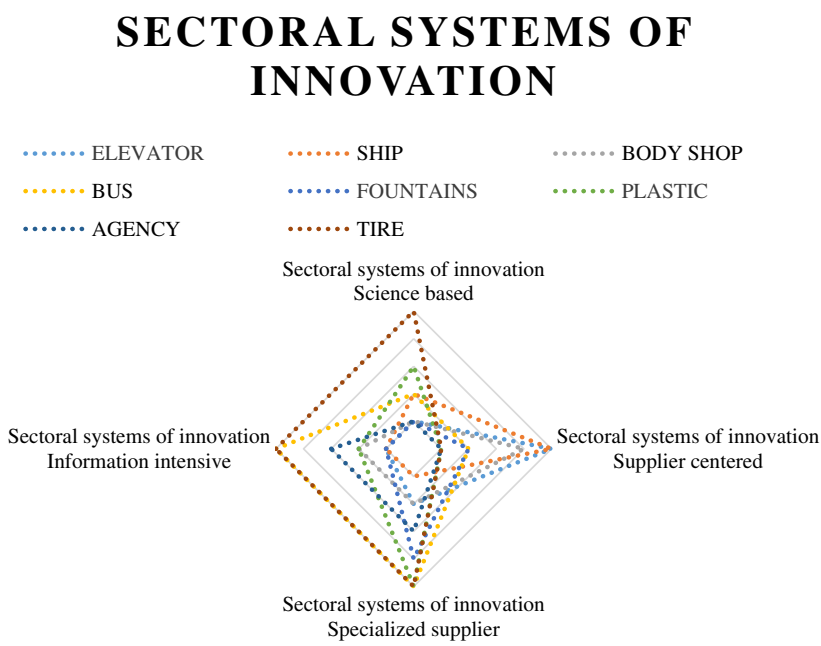

Fig. 3. Sectoral systems of innovation — External push or pull.

afloat. ICT platforms are necessary in harnessing external sources as a way to collaborate and create value [Child and McGrath (2001)]. Even so, implementing IT-driven innovation can cause missteps, ambitious (or not fully understood) partnerships and will further reshape business models (even to the point of shattering). In this regard, there is evident managerial challenge to properly evaluate business models and their new shape as well as aligning partners' incentives while retaining technology control. Collaboration increases the risk of knowledge leakage and, consequently, the costs of technology control [Frishammar *et al.* (2015); Rantapuska and Ihanainen (2008)].

The companies in this study are, most often than not, pushed toward more innovative actions by their suppliers or consumers. None of them, except from TIRE, has effective science-based sectoral system of innovation. There are those

Table 5. Matrix on sectoral systems of innovation.

	ELEVATOR	SHIP	BODY SHOP	BUS	FOUNTAINS	PLASTIC	AGENCY	TIRE
Science-based						X		X
Supplier-centered	X	X	X					
Specialized supplier				X	X	X	X	X
Information-intensive				X			X	X

X represents importance in the business model.

that entirely depend on a specific supplier/s (ELEVATOR or BODY SHOP) or are specialized suppliers (SHIP, PLASTIC, FOUNTAINS and in some aspects TIRE), which are pushed into innovative activities due to standardization procedures of external associates and networks. Nevertheless, the most information-intensive company in this sample that uses market pull tends to be BUS (AGENCY is still lagging on imposing more significant information-intensive automation), even though TIRE is just behind the corner on this issue and will eventually shift toward overall information-intensive digital processes.

6. Conclusions

Research and development processes in SMEs are quite flexible when it comes to utilization of external resources; therefore, introducing new technological trajectories, such as digital transformation, increases the likelihood of successful exploitation of new innovative approaches [Acs and Audretsch (1987)]. However, implementing an innovation strategy can cause problems and managerial oversights that are hard to have been foreseen.

In this study, we use multiple case study analyses and detailed approach to eight different companies disaggregating their present activities and potential in three lines of research. By classifying heterogeneous group of firms that operate in different industries, we aim at integration of their internal processes, business models and innovation strategies in order to see future possibilities and ways to introduce digitalization into state-of-the-art systematic approach, bring them from theory to practice and change their functional reality. Hence, the main contribution of this study is to define pathways, which when imposed on a certain case are to inflict positive change; creating an analytical framework based on solid theoretical grounds to derive practical and useful proposals and enriching current literature with region-specific case-based solutions.

First, the firms in this sample operate in a restricted internal context predefining their innovative and absorptive capacities, and there is a need to find a fine balance between their internal competencies and the external knowledge sourcing. In consequence, a gradual evolution of key competencies is to deter development of low-tech paths, reduce rigidness of the business model and propel innovative actions. Further, extending inbound innovation activities to their very limit might prove to be of use, but increasing their efforts toward outbound innovative activities is the next logical step of development. In this regard, digital transformation will inevitably improve process performance, reduce error costs and reshape existing business models toward more dynamic innovation possibilities.

Secondly, seeking benefits of outbound innovation has an end goal of acquiring market knowledge. Nevertheless, successful technology exploitation is contingent on raising search costs and sound process performance to mitigate raising error costs, thus setting priorities for scalable business models is a probability. Consequently, appropriability of scientific knowledge has to come to the forefront of innovation strategies; nevertheless, our set of companies is mainly comprised of those that utilize technological knowledge. Cooperation with academic institutions gives solid grounds

for sourcing knowledge (through partnership agreements or even co-development of technology) that can be further commercialized to access markets and develop market knowledge. Indeed, research centers within the firms or outsourced is a good way to approach application problems that arise due to lack of knowledge or internal context glitches. Absence of proper management capabilities to unforce digital transformation can cause lack of focus managing the firm in volatile environment or even commercial visibility difficulties, which are to be surpassed by appropriate guidance (for example, participation in industry, governmental or academia projects).

Thirdly, the analyzed firms are likely to continue to use external push/pull in various ways and forms. In this regard, sourcing of context-based appropriation strategies can maximize outputs and move companies closer to sectoral systems of innovation that are information-intensive (digitalization overhaul is the most likely course of action). Accessing different and more innovative paths of development might also mean collaborative research and development and intellectual property management, whereas increased managerial flexibility to appropriate and exploit innovative technology assets can mitigate risks of exposure to influx of knowledge. Hence, there are risks of losing control over technology because most of the firms in the sample function in supplier-centered or specialized supplier sectoral systems of innovation can be lessened by moving toward information-intensive practices.

Being able to accumulate and put into action external ideas is a way forward toward supplementing internal knowledge base; therefore, curial in escaping technological lock-ins and imposing efforts toward digital transformation offer favorable outcomes.

7. Limitations

As in any academic research, there are limitations that apply to the findings as well as major possibilities for future research. Indeed, more research is needed to fully understand the effect of innovation induced through digitalization as well as retuning business models. Indeed, the main limitations of this study are centered around the limited number of companies in the sample, focus on only two Italian provinces and are lack of econometric analysis of the collected evidence. Thus, it would be useful to confirm the findings of this paper using different methodologies and data sets; moreover, it would be interesting to learn more; on the one hand, the innovation potentials of business restructuring and, on the other hand, how digitalization changes process the overall management of the companies. Modified methodologies and new approaches that researchers introduce will eventually uncover many other specificities while scrutinizing the innovation aspects of digitalization.

References

Acs, Z. J. and Audretsch, D. B. (1987). Innovation, market structure, and firm size. *The Review of Economics and Statistics*, **69**, 4: 567–574.

Apostolov, M. (2016). Foreign direct investments induced innovation? A case study — Macedonia. *Comparative Economic Research*, **19**, 1: 5–25.

Apostolov, M. and Scagnelli, S. D. (2019). Foreign-versus domestic-owned firms in the predicament 'Cui bono'?*Business Systems Research*, **10**, 2: 18–36.

Arora, A. and Gambardella, A. (1994). Evaluating technological information and utilizing it: Scientific knowledge, technological capability, and external linkages in biotechnology. *Journal of Economic Behavior and Organization*, **24**, 1: 91–114.

Belderbos, R., Carree, M. and Lokshin, B. (2004). Cooperative R&D and firm performance. *Research Policy*, **33**, 10: 1477–1492.

Bell, J. and Loane, S. (2010). 'New-wave' global firms: Web 2.0 and SME internationalisation. *Journal of Marketing Management*, **26**, 3–4: 213–229.

Birley, S. and Westhead, P. (1990). Growth and performance contrasts between 'types' of small firms. *Strategic Management Journal*, **11**, 7: 535–557.

Bridges, W. (1986). Managing organizational transitions. *Organizational Dynamics*, **15**, 1: 24–33.

Brunswicker, S. and Vanhaverbeke, W. (2015). Open innovation in small and medium-sized enterprises (SMEs): External knowledge sourcing strategies and internal organizational facilitators. *Journal of Small Business Management*, **53**, 4: 1241–1263.

Cabrera, A. and Cabrera, E. F. (2002). Knowledge-sharing dilemmas. *Organization Studies*, **23**, 5: 687–710.

Cai, J. and Szeidl, A. (2017). Interfirm relationships and business performance. *The Quarterly Journal of Economics*, **133**, 3: 1229–1282.

Cardinal, L., Alessandri, T. and Turner, S. (2001). Knowledge codifiability, resources, and science-based innovation. *Journal of Knowledge Management*, **5**, 2: 195–204.

Castellacci, F. (2008). Technological paradigms, regimes and trajectories: Manufacturing and service industries in a new taxonomy of sectoral patterns of innovation. *Research Policy*, **37**, 6: 978–994.

Cesaroni, F., Minin, A. D. and Piccaluga, A. (2005). Exploration and exploitation strategies in industrial R&D. *Creativity and Innovation Management*, **14**, 3: 222–232.

Chesbrough, H. (2006). *Open Business Models: How to Thrive in the New Innovation Landscape*: Boston: Harvard Business Review Press.

Chesbrough, H. (2010). Business model innovation: Opportunities and barriers. *Long Range Planning*, **43**, 2: 354–363.

Child, J. and McGrath, R. G. (2001). Organizations unfettered: Organizational form in an information-intensive economy. *Academy of Management Journal*, **44**, 6: 1135–1148.

Dahl, M. S. and Pedersen, C. Ø. R. (2004). Knowledge flows through informal contacts in industrial clusters: myth or reality? *Research Policy*, **33**, 10: 1673–1686.

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

De Luca, L. M. and Atuahene-Gima, K. (2007). Market knowledge dimensions and cross-functional collaboration: Examining the different routes to product innovation performance. *Journal of Marketing*, **71**, 1: 95–112.

Dibrell, C., Davis, P. S. and Craig, J. (2008). Fueling innovation through information technology in SMEs. *Journal of Small Business Management*, **46**, 2: 203–218.

Di Minin, A. and Faems, D. (2013). Building appropriation advantage: An introduction to the special issue on intellectual property management. *California Management Review*, **55**, 4: 7–14.

Du, J., Leten, B. and Vanhaverbeke, W. (2014). Managing open innovation projects with science-based and market-based partners. *Research Policy*, **43**, 5: 828–840.

Edwards, T., Delbridge, R. and Munday, M. (2005). Understanding innovation in small and medium-sized enterprises: A process manifest. *Technovation*, **25**, 10: 1119–1127.

Ehret, M. and Wirtz, J. (2017). Unlocking value from machines: Business models and the industrial internet of things. *Journal of Marketing Management*, **33**, 1–2: 111–130.

Enkel, E., Gassmann, O. and Chesbrough, H. (2009). Open R and D and open innovation: Exploring the phenomenon. *R&D Management*, **39**, 4: 311–316.

Felin, T. and Zenger, T. R. (2014). Closed or open innovation? Problem solving and the governance choice. *Research Policy*, **43**, 5: 914–925.

Fleisch, E., Weinberger, M. and Wortmann, F. (2015). Geschäftsmodelle im Internet der Dinge. *Schmalenbachs Zeitschrift für betriebswirtschaftliche Forschung*, **67**, 4: 444–465.

Forsman, H. (2011). Innovation capacity and innovation development in small enterprises. A comparison between the manufacturing and service sectors. *Research Policy*, **40**, 5: 739–750.

Foster, A. D. and Rosenzweig, M. R. (2010). Microeconomics of technology adoption. *Annual Review of Economics*, **2**, 1: 395–424.

Frishammar, J., Ericsson, K. and Patel, P. C. (2015). The dark side of knowledge transfer: Exploring knowledge leakage in joint R and D projects. *Technovation*, **41–42**: 75–88.

Grandi, A. and Grimaldi, R. (2003). Exploring the networking characteristics of new venture founding teams: A study of Italian academic spin-off. *Small Business Economics*, **21**, 4: 329–341.

Greco, M., Grimaldi, M. and Cricelli, L. (2015). Open innovation actions and innovation performance. *European Journal of Innovation Management*, **18**, 2: 150–171.

Hossain, M. (2015). A review of literature on open innovation in small and medium-sized enterprises. *Journal of Global Entrepreneurship Research*, **5**, 1: 6.

Howells, J., James, A. and Malik, K. (2003). The sourcing of technological knowledge: Distributed innovation processes and dynamic change. *R&D Management*, **33**, 4: 395–409.

Julien, P.-A. (1995). New technologies and technological information in small businesses. *Journal of Business Venturing*, **10**, 6: 459–475.

Kaufman, A., Wood, C. H. and Theyel, G. (2000). Collaboration and technology linkages: A strategic supplier typology. *Strategic Management Journal*, **21**, 6: 649–663.

Lasi, H., Fettke, P., Kemper, H.-G., Feld, T. and Hoffmann, M. (2014). Industry 4.0. *Business and Information Systems Engineering*, **6**, 4: 239–242.

Lavrakas, P. J. (2008). *Encyclopedia of Survey Research Methods*. Thousand Oaks, California.

Leiponen, A. and Byma, J. (2009). If you cannot block, you better run: Small firms, cooperative innovation, and appropriation strategies. *Research Policy*, **38**, 9: 1478–1488.

Li, Y., Vanhaverbeke, W. and Schoenmakers, W. (2008). Exploration and exploitation in innovation: Reframing the interpretation. *Creativity and Innovation Management*, **17**, 2: 107–126.

Love, J. H. and Roper, S. (2015). SME innovation, exporting and growth: A review of existing evidence. *International Small Business Journal*, **33**, 1: 28–48.

Malerba, F. (2002). Sectoral systems of innovation and production. *Research Policy*, **31**, 2: 247–264.

Mathrani, S., Viehland, D. and Mathrani, A. (2013). Using enterprise systems to realize digital business strategies. *Journal of Enterprise Information Management*, **26**, 4: 363–386.

Miles, R. E., Snow, C. C., Meyer, A. D. and Coleman, H. J. (1978). Organizational strategy, structure, and process. *The Academy of Management Review*, **3**, 3: 546–562.

Mintzberg, H. (1989). The structuring of organizations. *Readings in Strategic Management*, eds. D. Asch and C. Bowman. Macmillan Education UK, London, pp. 322–352.

Muller, E. and Peres, R. (2019). The effect of social networks structure on innovation performance: A review and directions for research. *International Journal of Research in Marketing*, **36**, 1: 3–19.

Nielsen, C., Lund, M., Montemari, M., Paolone, F., Massaro, M. and Dumay, J. (2018). *Business Models: A Research Overview*. New York: Routledge.

Nieto, M. J. and Rodríguez, A. (2011). Offshoring of R&D: Looking abroad to improve innovation performance. *Journal of International Business Studies*, **42**, 3: 345–361.

Nieto, M. J. and Santamaría, L. (2010). Technological collaboration: Bridging the innovation gap between small and large firms. *Journal of Small Business Management*, **48**, 1: 44–69.
Oakey, R. P. (2013). Open innovation and its relevance to industrial research and development: The case of high-technology small firms. *International Small Business Journal*, **31**, 3: 319–336.
Osterwalder, A. and Pigneur, Y. (2013). *Business Model Generation: A Handbook for Visionaries, Game Changers, and Challengers*. Thousand Oaks, California: Wiley.
Parente, S. L. and Prescott, E. C. (1994). Barriers to technology adoption and development. *Journal of Political Economy*, **102**, 2: 298–321.
Parida, V., Westerberg, M. and Frishammar, J. (2012). Inbound open innovation activities in high-tech SMEs: The impact on innovation performance. *Journal of Small Business Management*, **50**, 2: 283–309.
Pavitt, K., Robson, M. and Townsend, J. (1989). Technological accumulation, diversification and organisation in UK companies, 1945–1983. *Management Science*, **35**, 1: 81–99.
Rantapuska, T. and Ihanainen, O. (2008). Knowledge use in ICT investment decision making of SMEs. *Journal of Enterprise Information Management*, **21**, 6: 585–596.
Ritala, P., Olander, H., Michailova, S. and Husted, K. (2015). Knowledge sharing, knowledge leaking and relative innovation performance: An empirical study. *Technovation*, **35**: 22–31.
Sanchez, R. and Mahoney, J. T. (1996). Modularity, flexibility, and knowledge management in product and organization design. *Strategic Management Journal*, **17**, S2: 63–76.
Scagnelli, S., Vasile, L. and Apostolov, M. (2019). Survival drivers of post-incubated start-ups: The effect of academic governance. *International Journal of Innovation Management*, **23**, 07: 1950062.
Spithoven, A. and Teirlinck, P. (2015). Internal capabilities, network resources and appropriation mechanisms as determinants of R&D outsourcing. *Research Policy*, **44**, 3: 711–725.
Tosi, H. L. and Slocum, J. W. (1984). Contingency theory: Some suggested directions. *Journal of Management*, **10**, 1: 9–26.
van de Vrande, V., de Jong, J. P. J., Vanhaverbeke, W. and de Rochemont, M. (2009). Open innovation in SMEs: Trends, motives and management challenges. *Technovation*, **29**, 6: 423–437.
Vossen, R. W. (1998). Relative strengths and weaknesses of small firms in innovation. *International Small Business Journal*, **16**, 3: 88–94.
Wagner, S. M. (2012). Tapping supplier innovation. *Journal of Supply Chain Management*, **48**, 2: 37–52.
West, J. and Bogers, M. (2017). Open innovation: Current status and research opportunities. *Innovation*, **19**, 1: 43–50.
Wirtz, B. W., Pistoia, A., Ullrich, S. and Göttel, V. (2016). Business models: Origin, development and future research perspectives. *Long Range Planning*, **49**, 1: 36–54.
Yin, R. K. (2009). *Case Study Research: Design and Methods*. SAGE Publications.
Zaridis, A. D. and Mousiolis, D. T. (2014). Entrepreneurship and SME's organizational structure. Elements of a successful business. *Procedia — Social and Behavioral Sciences*, **148**: 463–467.
Zott, C. and Amit, R. (2007). Business model design and the performance of entrepreneurial firms. *Organization Science*, **18**, 2: 181–199.

Biography

Mico Apostolov, PhD, is an Associate Professor at UGD, Stip, Macedonia & Adjunct Professor at Università degli Studi di Torino (Dipartimento di Management) and Visiting Scholar at Università Ca' Foscari Venezia (Dipartimento di

Management) (2018–19). Also, he is an alumnus of Scuola Superiore Sant'Anna (Normale di Pisa), Pisa, Italia, an alumnus of University of California, Berkeley – Haas School of Business, CA, USA and anciens du Collège d'Europe, Bruges/ Natolin.

Nunzia Coco obtained her PhD in Management from Ca' Foscari University of Venice, Italy. She is currently a Research Associate at ETH Zurich. She joined academia after many years of design professional work for small, medium and large companies in diverse settings. Her main interest regards the role of design as a driver for innovation and co-creation.