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DESIGN MANAGEMENT AS A DOMAIN OF SMART AND SUSTAINABLE ENTERPRISE: BUSINESS MODELLING FOR INNOVATION AND SMART GROWTH IN INDUSTRY 4.0

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Abstract. The prior research has scrutinised the extent and scope of design integration for smart production and services innovation and value generation for smart society including enterprises, customers and end-users in the context of Industry 4.0. A conceptual approach has been proposed for practical business applications in developing and exploiting new innovative products or services. The present paper underpins the earlier research in methodological terms and is an affiliated research endeavour. The research traces successful performance of small and medium-sized enterprises (SMEs) within the context of Industry 4.0 in correlation with design as a source, resource and strategic tool for value generation and its capitalisation on the market. Building upon the integrated design as a tool and process for innovation capacity in the current industrial development paradigm, the present paper contributes to the previously anticipated research objective to reveal how design integration and design management manifest within small business practices and to what extent creates value. The key research focus is placed here on the strategic business orientation – business modelling and value creation for SMEs driven by impact factors from design, innovation management and strategic management field in the context of entrepreneurship. The present research is a result of qualitative research activity based on the case study methodological approach. Empirical data suggest how small enterprises within the Industry 4.0 domain can accelerate their growth targets and become more innovative, innovation being the move towards sustainable competitiveness and smart growth.

Keywords: design-driven business model, design value, design impact, design measuring, industry 4.0, small and medium-sized enterprises

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1. Introduction

In the Communication of the European Commission COM (2012) “Entrepreneurship 2020 Action Plan – Reigniting the Entrepreneurial Spirit in Europe”, it is stated that future growth and competitiveness needs to be smart, sustainable and inclusive addressing our principal societal challenges. Europe is depending on entrepreneurs in order to bring Europe back to growth and higher levels of employment (COM(2010) 2020 final; COM/2014/014 final; SWD(2014) 14 final). In the landscape of industrial (r)evolution (‘Industry 4.0’ or ‘Internet of Things’), entrepreneurship is particularly important to accelerate development of the six emerging industrial and social growth sectors according to the Communication from the Commission (COM(2012) 582 final, p. 4). Smart and sustainable growth for 2014-2020 milestone necessitates innovation and research, digital agenda, support for and SMEs and low-carbon economy (SWD (2014) 120 final, p. 7). All of the four focus fields already reveal the linkage with Industry 4.0.

Linking up with the prior research, the author believes that what is highly missing in the context of Industry 4.0 and smart entrepreneurship growth is not a business model based digital and information technologies, strategic management and firm research solely (Inglewood & Youngs, 2014; Burmeister *et al.*, 2015; Westerlund *et al.*, 2014; Blythe, 2014; Fleisch *et al.*, 2014; Dujin *et al.*, 2014; Kagermann, 2015), but rather one evolving from design integration into business for innovations supported by strategic orientation. It is about thinking and acting in a smart way and becoming a part of smart society (SWD(2013) 380 final; SEC(2009) 501 final). Impact and value of design for innovations – competitiveness and smart growth – should not be marginalised any longer also in this field, as it happened with other business domains, where design has been acknowledged as a source, resource, tool or approach within the strategic management, product development and innovation management arrays (McNabola, 2013; UK Design Council, 2013; Micheli, 2013, 2015; Mortati, 2015; Borja de Mozota, 1998, 2003; Kortesoja, 2013; Maroni *et al.*, 2013; Gerlitz, 2015).

Design integration must go beyond design thinking approach emerged as a new business model within the design management evolutionary paradigm (Boland and Colopy, 2004; Borja de Mozota & Kim, 2009; Brown, 2008; Brown & Whyte, 2010; Martin, 2009; Meinel & Leifer, 2011; Plattner *et al.*, 2011). In this industrial era, design should become the core of design-driven business model for SMEs, and design management – take a step forward – leaving aside obsolete tenets and taking the move towards smart tool, process and approach for innovations, competitiveness and growth of SMEs in this high-tech and digitised industrial paradigm. Indeed, Industry 4.0 related research have already emphasised the need to rethink existing business models as a result of pervasiveness of digital and new information technologies, increasing virtual communication and open communities (Turber *et al.*, 2014; Burmeister *et al.*, 2014). Thus, this research reconsiders the time as being appropriate one not to miss design integration into business in Industry 4.0 and avoid any possible challenges in entrepreneurship, which, as the real business practices show, can be solved by bringing in design in operational, strategic or social-environmental business dimension to create value. As a result, the research endeavour complements the prior research from the Industry 4.0 perspective and, structured in a similar way, advocates design integration in SMEs practices using a case study approach.

2. Literature review

In the strategy management, organisation and innovation related literature, smart, sustainable and inclusive growth has been often linked with Industry 4.0 and discussed through the business modelling and information technology perspective (Sun *et al.*, 2012; Eckert, 2014; Brettel & Uckelmann 2014; Rivard *et al.*, 2006; Kemp, 2014), competitive advantage or business strategy perspective (Bucherer *et al.*, 2012; Porter & Heppelmann, 2014; Veit *et al.*, 2014). A series of responses has been proposed in order to integrate industry 4.0 tenets within

industrial and entrepreneurial practices to advance business performance and growth. As a result, numerical research outputs forecasting the future potential of Industry 4.0 have entered academic and practice-oriented landscape, e.g. proposing business models for Industry 4.0 and within it (Fan & Zhou, 2011; Leminen *et al.*, 2012; Ueckelmann *et al.*, 2014; Hui, 2014; Chan; 2015). A new rethought business model adapted to digital technologies and digitisation, advanced manufacturing technologies, merging virtual and real worlds, increasing automation and intensifying information flows, which enable to acquire competitive advantage (Porter & Miller, 1985; Porter, 1996; Moody & Walsh, 1999; Porter & Kramer, 2006; Porter, 2008; Li *et al.*, 2012; Tvaronavičienė, Černevičiūtė, 2015), including openness and open innovation sources as well as Internet importance among socio-economic stakeholders (industries, businesses, costumers and user communities) and emerging role of communities (Jawecki *et al.*, 2011; Füller & Matzler, 2007; Füller *et al.*, 2011, 2012; Gault, 2012; Dell’Era & Landoni, 2014; Baldwin & von Hippel, 2009; von Hippel *et al.*, 2011, 2012) has been put on the demand list of scholars and researchers.

From the conceptual point of view, the adopted concepts and design can be linked via their objective boundaries and content meanings, as they are likely to share similar common content threads. Industry 4.0 aims at assuring high-tech manufacturing location, jobs and welfare to people in a certain region to generate the competitive advantage (Ramsauer, 2013, p. 6; Avigdor *et al.*, 2014, p. 2; Krückhans and Meier, 2013, p. 31) and concerns design, manufacture, operation and service dimension of the manufacturing industry, thus including product, services and enterprise dimension as well as operational, strategic and environmental level. Smart specialisation is linked with competitive advantage and strategy, since it is a strategic approach aiming at developing a vision and identifying a competitive advantage setting strategic proprieties and making use of smart policies to maximise the knowledge-based development potential (David *et al.*, 2009, p. 1; SWD (2014) 120 final, p. 17). It also sets out to generate knowledge about the future economic value of a possible structural change and to discover the best suitable domains of specialisation by entrepreneurs (Foray *et al.*, 2011, p. 8). Innovation dimension can be added as additional needed capacity to smart specialisation and thus smart growth. It finds the roots in the innovation systems literature, the entrepreneurship and growth (OECD, 2013). As a result, three key tenets are associated with the concept: it recognises economic potential and growth via entrepreneurial search processes during which (1) distribution of potential opportunities for technological improvements in a specific sector, activity or profession is identified; (2) exploitation of the innovation results is ensured and (3) learning from outcomes regarding opportunities and scope of innovations is applied (McCann and Ortega-Argiles, 2015, pp. 1292-1293; Foray and Goenega, 2013, p. 1). In fact, smart specialisation strategies forge competitive advantage by obtaining the most efficient innovation results by means of effective prioritising scarce resources or concentrating resources on certain domains of expertise, e.g. industry, education and innovation (Ortega-Argiles, 2012, p. 2). Adding to this resource-efficient, greener thinking and competitive acting, Europe might arrive and not only smart, but also sustainable growth by 2020 (COM (2010) 2020 final, p. 5).

Sustainable growth, the same as smart growth, is dependent on entrepreneurship growth (Voss, 1998; Vossen, 1999; Delgado *et al.*, 2014; Mettler & Williams, 2011, Ayyagari *et al.*, 2011; Fraser, 2010; O’Gordman, 2001). Sustainable entrepreneurship is subject to efficiency and effectiveness, sufficiency and consistence (Young & Tilley, 2006, p. 402, Gerlach, 2003, p. 101), it aims to deliver profit and improve environmental sustainability and social conditions, i.e. setting long-term economic and business outputs deriving from entrepreneurial opportunities (Cohen & Winn, 2007, p. 35). In entrepreneurship, it requires a more specific focus by SMEs on social responsibility, environmental awareness, i.e. intertwining of all three dimensions of sustainability, i.e. economic, environmental and social ones (Cliberti *et al.*, 2008, p. 1580). Sustainability issues encompass such indicators as product-based green supply, environmentally friendly decision-making, cost reducing. In fact, sustainability might refer to issues, whether environmental, ethical or social ones (Seuring and Müller, 2008, p. 456).

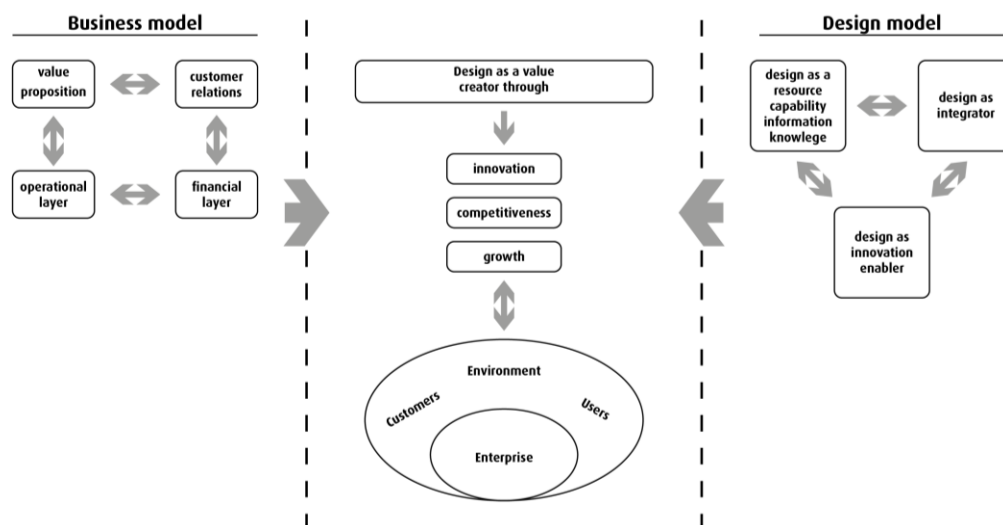
3. Framework for analysis and measurement

Being important vehicle of regional and national economy, SMEs have become a topical issue. Innovation, competitiveness and growth are key business success variables articulated by science and practice. According to the EU Policy Paper “Regional Policy for Smart Growth of SMEs”, the key aim is therefore to increase the strategic focus of SMEs by making them more innovative, thus contributing to competitiveness and growth, as innovation is the key to both (p. 1). To envisage such a business success – smart and sustainable growth, business and design domains have been leveraged and merged as a result of sharing common grounds for creating and exploiting value for SMEs:

- (1) Design domain integrating tenets of value creation and exploitation – design for innovation, competitiveness and growth.
- (2) Business domain embracing value creation and capturing residing in strategy and competition, innovation and business modelling.

The stated below underpins the conceptual inter-linkage of perception of innovations, competitiveness and growth from cross-disciplinary perspective. As a result, the author hypothesises that existing similarities support design integration in business interactions and proposition of design-driven model application for enterprises, contributing towards the anticipated key success factors, a business model, which answers essential questions of archetypal business model who, what, how and why (Gassmann *et al.*, 2014, p. 90ff).

Fig. 1. Merging Design and Business Domains in Industry 4.0



Source: compiled by the author

3.1. Design domain to innovation

Strategic role of design and inter-linkage of design and innovation is used to be the research objective in the context of service design. Strategic role of design has been also frequently revealed through the lens of the ‘customer value’ (Schmiedgen, 2011, p. 1; Wetter Edman 2011, p. 41; Chiva & Alegre, 2009; Meier-Kortwig, 1997; Brown, 2008). Design innovation modelling and thus business modelling has been linked through service design approaches (mostly, design thinking). Nevertheless, the role of other driving parameters and factors for business model and strategy from the design management related literature seem to be underestimated (Borja de

Mozota, 2013, p. 296). In fact, is an important to link all the actors in the innovation process, both inside and outside of the firm and to establish and maintain the role of designer as a ‘gatekeeper’ facilitating such linkages (Walsh, 2000, p. 88).

Starting from 1990s, there can be observed a trend of ‘advocacy’ of design in the management field and demystification of design among managers (Gorb and Dumas, 1987; Oakley, 1990; Walker, 1990). Design management should be employed within management in form of design resources available to an organisation aiming to achieve its corporate objectives. The issue of design leadership and its role for corporate identity get at increasing attention among scholars and practitioners, e.g. Koppelman, 1993; Blaich and Blaich, 1993; Davies, 1993; Gorb, 1990; Topalian, 2002; Turner, 2013, etc. from 1990 onwards. Placement of design within an organisation, identification of design resources and related issues for solving key management issues and trainings of managers to effectively use design (Gorb, 1990, p. 2). Similarly, however, with a stronger view on long-term corporate mission and vision, Blaich and Blaich (1993) conceive design management as a programme of corporation activity focused on communication of design relevance to achieve long-term goals of an organisation and coordinate design resources on all applicable organisational activity levels, thus enabling to achieve corporate objectives (pp. 13-15). Similarly, Turner (2013) links design management with corporate strategy and vision. It is as a tool enabling to achieve this, and design leadership – a means to define the future, i.e. vision. Both are critical sources to value achievement and its maximisation. Fundamentally, Turner conceives design management and its role in delivering successful design solutions in an efficient and cost effective way (ibid., 72). In this, it can be stressed, here, the focus clearly shifts from design management as being solely employed on functional and operational levels towards its embeddedness within the corporate strategic level.

Today, strategic design management research frequently addresses design as a resource, core competency, capability and capital. Its role moved from just fitting to the industry towards becoming heart of the business model and value creation (Borja de Mozota, 1998, p. 26; Borja de Mozota & Kim, 2009, p. 67). It is a competitive advantage and strategy. It is a process and styling leading towards strategic competitive advantage (Borja de Mozota, 2006, p. 45ff). Design has increasingly become perceived as a strategic tool, whereby information and knowledge about a product from which it can be materialised and positioned on the market, thus creating and capturing value (Kotler and Rath, 1984; p. 16; Er, 1997, p. 293). As a result, design integrates all the strategically essential methods, tools, capabilities and resources accumulated and deployed from the three domains: design, business and technology (Prause *et al.*, 2012, p. 441; Hack *et al.*, 2012, pp. 140-141). Design became differentiator (1), integrator (2), transformer (3) and a good business (4) (Borja de Mozota, 2006, p. 45). Design may influence products offered by a firm giving them sense. Being design as a source of making sense of things, design implies messages to the user, within the styling (e.g. form), functionality of a product, service or process, emotional and symbolic value, i.e. meaning. Meaning proposes to users a system of values by using a specific language, e.g. signs, symbols and icons that deliver the message (Verganti, 2008, p. 440). As a result, design can be used as a resource in several ways: as a strategy, as a method, as a styling, as internal enterprise resource, as valuable knowledge and as a process applied in enterprises.

3.2. Business approach to innovation

Value creation has been heart of business modelling, innovation, business strategy and organisation discourses (Hui, 2014, p. 2; Magretta, 2002, p. 87, etc.). Already Porter & Miller (1985) by proposing the value chain highlighted the importance of information for competition as well as that of information technology. Value emerges along the entire value chain and is at the end confirmed by the customer via mutual transactions (usage of product or service) (p. 154). Later, big data and data management were considered as changing value proposition and value chain (Nagle & Sammon, 2014, p. 397). Similarly, change in service logic implied value creation with goods as value supporting resources and services as value supporting processes (Grönroos, 2006, p.

325) or change in producer-customer paradigm, where value embedded in an physical artefact is exchanged with customer and customers are part of a service seen as a resource or integrating resources (Lusch *et al.*, 2008, p. 10; Vargo *et al.*, 2008, p. 145; Prahalad & Ramaswamay, 2004, p. 5).

Beyond the ‘classical’ manufacturing enterprise’s and supply and value chain perspective on value creation (Porter & Miller, 1985; Porter, 1995; 1996) and perception of value creation through the lens of ‘service logic’ (Lusch *et al.*, 2004; Vargo & Lusch, 2004, 2008), recently research community has started to focus on value from the angle of strategy as basis for value creation (Osterwalder & Pigneur, 2010; George & Bock, 2011; Zott *et al.*, 2011; Osterwalder *et al.*, 2014; Gassmann *et al.*, 2014) or innovation (business innovation model) (Chesbrough & Rosenbloom, 2002; Chesbrough, 2010; Teece, 2010; Bucherer *et al.*, 2012; Amit & Zott, 2012; Andries & Debackere, 2013; Foss & Saebi, 2015; Ignatavičius *et al.* 2015). In fact, a business model finding its roots in 1957 (Bellmann *et al.*) should allow a holistic view on an enterprise by combining factors located inside and outside the firm (Turber & Smiela, 2014, p. 4). This is a clear link towards the two sides of the coin, i.e. internal and external organisational perspective – external environment approaches as shaped by Porter fitting strategy to the external environment, and internal scrutinising enterprise, deconstructing the competitiveness and innovation within the domain of key resources, capabilities, competencies (Wernerfelt, 1984; Barney, 1991; Amit & Shoemaker, 1993; Peteraf, 1993; Prahalad & Hamel, 1990; Hoopes *et al.*, 2003; Helfat & Peteraf, 2003; Crook *et al.*, 2008; Foss, 2011, etc.; Rezk *et al.*, 2015).

Enterprise and innovation as intertwined construct have been perceived already by Drucker (1985), Zhao (2005) and frequently discussed within business model innovation discourses (e.g. Amit & Zott, 2012; Teece, 2010, etc.). Here, again, the heart of the business innovation model is innovation process and the ability to identify a good idea including capacity transforming such idea into a business model that adds value and generates revenue (Andries & Debackere, 2003, p. 337). There is a need to integrate all interdependencies and to combine them into one consolidated approach, an integrated structure of products, services and information flows including the involved actors and roles as well as the potential value created for all participants and the source of revenue (Sun *et al.* 2012, p. 3). It is business pattern of components, linkages between them and dynamics. It is a systematic approach implying construction of certain ‘success elements’. There are nine elements comprising four building blocks within business models: value proposition, operational and financial model and customer relations (Osterwalder & Pigneur, 2010, p. 252; Chesbrough & Rosenbloom, 2002, p. 551; Kindström, 2012, p. 483; Zott *et al.*, 2011, p. 1020ff; Tikkanen *et al.*, 2005, p. 790). These building blocks are also referred to as balanced systemic approach consisting of financial, internal business process, customer and learning and growth (innovation) dimensions, which make up a balanced system towards strategy – balanced scorecard (Kaplan & Norton, 1996, p. 56; Kaplan & Norton, 2005, p. 5), as strategy maps (2006, p. 105) or even activity system maps enabling to achieve competitive positioning and implement strategy (Porter, 1996, p. 60ff). As frequently emphasised, value proposition of a business innovation model is heavily subject to products and services offered by an enterprise and its operational model, and therefore products and services innovation can lead to business model innovations. Nevertheless, the innovation is not limited to dominant product or service process innovations (Bucherer *et al.*, 2012, p. 184). In fact, a broad variety of ‘ingredients’ are needed to achieve value.

4. Methodology

The present research applied a hybrid research approach (Fereday & Muir-Cochrane, 2006, p. 80) combining inductive and deductive perspectives, analysing and interpreting raw data and identifying key tenets that enable to capture the key phenomenon – design integration and its value for SMEs. Starting from thematic analysis, locating the applicable thematic research streams, developing a framework for analysis and measurement, the research aims at answering two fundamental research questions:

- (1) How can design be integrated within entrepreneurial strategic orientation and accelerate business model?
- (2) To what extent can design integration and design value be traced within SMEs in Industry 4.0 context?

A following research path characterises the methodological research approach. First, the paper builds upon design perception as integrated design management approach for innovations (using deductive reasoning) and traces smart ideation and exploitation patterns in a given enterprise (case study) on operational, strategic and social-environmental dimension based on the accumulated evidence gathered. Subsequently, potential business model integrating design, innovation and firm management perspective is developed and validated by manifold field research activities (inductive reasoning) proposing how value can be generated and exploited for smart entrepreneurial growth (inductive). As emphasised by Kelley (1998), within design related discourses, an inductive approach to innovation is dominating (p. 32). Although the research combines the mix of deductive and inductive intentions, when using a qualitative case study to build the design-driven business model for Industry 4.0, it relies, however, on integration of theoretical reflections (the framework). It serves as a foundation and common ground for the analysis and results' synthesis, although the theoretical reflections usually are not employed within the analysis phase. Here, using a specific structured approach by means of the developed outline (Fereday & Muir-Cochrane, 2006, p. 80; Crabtree and Miller, 1992, pp. 93-109), the research adopts a framework for analysis and measurement as a certain template with specific applying indicators (Fig. 1) and uses it for the phenomenon observation purposes and data validation. In fact, employment of the framework underpins credibility of the research by providing a specific approach towards dealing with evidence and facilitates transparency. Consequently, observations made allow articulating a new conceptual perspective on design integration and its role within Industry 4.0 discourses – a model, which can be employed within SMEs businesses.

The choice and adaptation of qualitative research approach has been justified taking into account applicable research streams (Neergaard & Uhløi, 2007, p. 1; Fossey *et al.*, 2002, p. 717), where qualitative research approach has been dominating. In the last decades, increasing role has been ascribed to the case study as being very crucial in making conceptual models (Eisenhardt, 1989; Miles and Huberman, 1994, p. 101; Stake, 1995, pp. 4-6; Yin, 2009, p. 2; 2012, p. 3). Further, as has been observed, whereas surveys were usually employed in the context measuring the business performance in a particular industry SMEs, case studies dominated research focusing on linkage of design and innovation, new product development as well as in research contributions related to the strategic management and the business strategy, i.e. emerging, developing and growing SMEs, e.g. Borja de Mozota, 1998, 2002.

The research process implies the following steps of the qualitative study, such as case selection, data collection, data preparation, data analysis, data interpretation and validation as well as data utilisation for theoretical and managerial contributions. The qualitative research applies such research methods as case study method (Yin, 2009, 2013), thematic analysis method (Braun & Clarke, 2006), interviews with enterprise representatives, field notes, diagrams and memos as well as social network analysis. They are recognised as being appropriate for examining design management practices and their role for small businesses and design management networks, as they enable to trace the links and to investigate relationships of interacting structures and units, in this particular case of that within a given enterprise (Wassermann & Faust, 1994, p. 8; Scott, 2003, p. 38ff; Corbin & Strauss, 2008, p. 123ff). In fact, the case study enables to catch the particularity and complexity of a single case (Stake, 1995, p. xi). The research type is therefore exploratory, interpretative, integrative and practice-oriented. It is also reflective showing how the research was produced, described and justified. The research scale is rather small, as it involves a single case study – a perception of design integration within strategic orientation and business modelling in one given enterprise. Nevertheless, the conceptual implications imply generalisation potential, i.e. a piloted design-driven model, which can be tested within an increased number of further observations of this phenomenon.

5. Case of Merging Design and Business Domains: A Design-Driven Smart and Sustainable Enterprise

Building upon the previous topical research within Industry 4.0 context, this research attempt showcases design performance, i.e. its integration and implication patterns on the enterprise level. Design is likely to be the driving force on operational, strategic, and socio-environmental level of the enterprise (its external performance on the market and linkage with customers). It implies a common thread embedded in all enterprise interactions, from the manufactured goods, over service proposition and customer management related to produced goods or services towards self-supporting value networks. Within Industry 4.0, design is a networked activity, source, resource, competency and capability. It enables and facilitates connectivity of an enterprise from internal and external perception. A new network is emerging that supports value creation for enterprise (revenue generation) and value proposition for its customers and end-users.

The case company is the small enterprise from Berlin, Germany. The SME offers planning, production and implementation of ideas – products and services. Through the three key business areas – product development, related knowledge accumulation and transfer and working drawing including workshop, the enterprise has established strong horizontal links with potential customers and users from different sectorial affiliations – science, research, business, service providers, network users, etc. Value creation occurs simultaneously, is manifold source-driven and connected with design being at the heart of the enterprise. For confidential purpose, the name of the enterprise is not disclosed, especially taking into account its size and therefore potential negative exposure on its growth. This, however, does not affect the reliability and validity of the research results.

The justification of this case study builds upon self-supporting evidence. First, the motivation to canvas the design impact for entrepreneurial practices, especially of those being very small or start-ups is clearly supported by the research evidence. There is to less attention have been paid towards revealing design impact, design practices and implications within smaller SMEs (Gemser and Lenders, 2001; Hertenstein *et al.*, 2005; Moultrie *et al.*, 2007; Fernandez-Mesa *et al.*, 2013, Erichsen, 2014; Kortesoja, 2013; Maroni *et al.*, 2015). As a result, there is an increasing research impetus to provide smaller enterprises with potential guides on how to harvest design for operational efficiency and effectiveness, strategic orientation and acknowledgement by customers and users. Second, the case study suits well the given landscape. Instead of selling products or services solely on the market through design-driven innovation, where innovation is usually associated with the operational readiness needed for products and services development and implementation on the market, the given enterprise adopts a different view. It sells a mixed commodity, a value proposition for different customers groups, varying from those of using products to those using a particular service attached to this enterprise. It proposes therefore a value, which does not solely belong to the upstream (production) or downstream (activities). By contrast, it encompasses the entire enterprise and its ecosystem (Leminen *et al.*, 2012). Third, the selected case shows the context proximity, i.e. the enterprise has been chosen from Germany as being birthplace of Industry 4.0 trend (Gerlitz, 2015). By contrast to the ample cases on Industry 4.0 and business models, this research scrutinise how Industry 4.0 is perceived and employed within small business practices in relation to design. Fifth, the research claims that design integration supports not only smart, but also sustainable performance of enterprise on operational, strategic, social and environmental (external) level. Indeed, the enterprise was chosen for the case study, as it envisages the vision of sustainable development and proposition of sustainable solutions to its customers. Particularly, the SME adopted within its business practices the environmental tenets calling for the sustainable development owing to the proceedings of the UN Environment Conference and World Summits on Sustainable Development. As a result, the SME contends developing smart, ecologically and environmentally friendly solutions intertwining ecology, economy and social dimension into one ecosystem.

In what sense is then this enterprise being smart and sustainable in the context of Industry 4.0? Along the three key aspects delimited in the framework, the integration of design is scrutinised from the value creation perspective being the heart of the business model. Accumulated identified patterns of design ‘performance’

along the entrepreneurial practices are presented, which are needed to match them to the construct of design-driven strategic orientation of SME and therefore integrate into the research setting. Subsequently, the author shortly elaborates on findings, articulates analytical statements and illustrates them by using the examples and data from the case. The succeeding research will require for generalisation of the ‘distilled’ patterns of design integration and its value creation potential.

Design as A Domain for Innovation

As the empirical data from the case study demonstrate, design is a core activity and stepping stone within certain projects. In a given enterprise, designer is at the core of the firm. Design enables to deliver innovations through the incremental process, from the idea to the developed product or service. As contended within personal interviews and observations, design ranks the highest position when it comes to its perception as a source of innovation. Design, the same applies for innovation, introduces a new meaning and value for its consumers, i.e. a new or significantly improved good or service, process or new marketing method, new organisational methods in business practice, workplace organisation or external relations (OECD/ EC, 2005, p. 46). As contended by the CEO and top managers of the enterprise, design enables to ‘design’, i.e. develop solutions, which match the needs and demand of the society – customers and end-users. The developed solutions, however, showcase clear linkage of functional, aesthetical, meaning and visual match expressed through a form (product) or solution (service or process). In fact, the developed solutions must clearly underpin functional dimension. Furthermore, for this specific enterprise, design enables product development from the idea towards the maturity phase. Particularly, different number of developed solutions and prototypes in the field of sustainable design enables diversification – application of solutions to a range of options, thus enabling quantification of design-driven innovation solutions. Innovation implies a process during which all the necessary activities such as problem resolving and /or idea generation, development, manufacturing and marketing of a new construct (would it be product, service, or process itself) are effectively and efficiently managed and commercially and practically exploited to the market (Trott, 2012, pp. 12-15). Innovation is to be viewed as a process of turning opportunity into new ideas, ensuring its practical application in the reality (Tidd & Bessant, 2013, pp. 18-22) and bringing value through its availability and access to it for its users via the market and/or other channels or distributed peer-to-peer and / or by the market (Gault, 2012, p. 122). Design is a tangible outcome, i.e. end product of the process or intangible, e.g. service or process, solution, etc. (von Stamm, 2004, p. 11).

Thus, design being key innovation source and designer as key enabler to innovate allows developing smart and sustainable products. As the case data show, design stands for a basic requirement for all sustainable and smart solutions’ development. In Industry 4.0 context, such innovative solutions can be developed faster, particularly using prototyping devices – software such as computer-aided design (CAD), 3D printer or other rapid prototyping methods. It is interestingly, however, that everybody, who has infrastructural, financial and internal capabilities and capacities to develop solutions, can use today such tools and methods. Indeed, technological advancement, increasing interconnectedness of machines and people, better possibilities to respond to customers needs and recognition by end-users facilitates faster innovation potential. However, the research results imply that technological and managerial capabilities are not enough. It contends that design and related capabilities residing in design, when combined with technology and business dimension, can lead towards mature innovations – smart and sustainable ones. Particularly, design-driven innovation is underpinned, it is argued here, through internal design capabilities and competencies, i.e. designer being at the heart of the enterprise or designers, who are working within the enterprise. It is far less evident that smart and sustainable solutions emerge when outsourcing design related services. In fact, design needs to meet enterprise culture, shared values, thinking and acting expressed through operational and strategic setting. According to the data, enterprise perception of design impact on innovation is the following. Using the seven-point scaling, the author has measured the potential of design for innovation in the enterprise. For this, the researcher has constructed three

impact layers, which showcase the magnitude of the particular parameter for innovations: essential (+++), average (++) and marginal to absent (+ / 0) and clearly underpin the analytical statements above.

Table 1. Design Domain and Innovation

Design is a source of innovation within the enterprise	+++
Design implies important development process of SME	+++
Design improves production and / or service provision development and provision processes	+++
Design improves products, services and process in SME	+++
Design enables achievement of the required product, service or process quality	++
Design supports development of new technologies, methods and tools in SME	+++
Design Domain's Magnitude	Essential

Source: compiled by the author

Design as A Domain for Competitiveness

Innovation is key towards business success, processes, products, services and other internal and external optimisation patterns. Innovation might be regarded as a key for SMEs to develop, grow and mature on the market. Becoming innovative forges also the level of competitiveness and affects the pace of growth. Taking into account the evidence from the given enterprise, it can be argued that the competitive edge derives from smart combination of resources, capabilities and competencies. It is also based upon external perception and customer relationships. The principal competitiveness might lay in the fact that the enterprise, also being very small, builds upon the tenet of providing a complete solution package, including both product and service attached to this product. Further, a certain perception towards social and environmental setting outside the company can be considered also as a potential source of competitiveness. The enterprise claims on complying with environmental friendly principles, emphasises the coexistence with and recognition of resources scarcity. Developed solutions do not stand just for a specific artefact. By contrast, it can be asserted that they implicate a combined approach in a smart way proposing a commodity integrating creative, managerial and social perspectives. Finding customers, which do acknowledge such solutions calling for a more sustainable thinking and acting complements the competitiveness. The enterprise has specialised in terms of offering sustainable solutions, which save energy, reduced maintenance and waste generation and enables cost saving in terms of operational, social and environmental parameters. Key customers are being integrated into the product or service delivering process at an early stage. Designer acts as service provider showing the benefits of the final commodity – functional excellence, positive ecological footprint and social recognition. It is move towards sense making for customers and end-users. Indeed, design is a powerful source of the enterprise competitiveness that, however, needs to be generated, smartly intertwined and exploited. The enterprise's top management perception towards potential of design to facilitate enterprise competitiveness in the parameters below (i.e. correlation between design capability to support and thus strengthen the competitiveness) are displayed as follows:

The empirical evidence showcase that design as a source alone cannot provide enterprise with differentiation strength yet, thus being able as enterprise to differentiate itself from the competitors. Design facilitates improvement of external performance of the enterprise on the market through, e.g. marketing activities or supports enterprise corporate identity and positive image building. This means that despite the fact that design role for competitiveness is evident and moving towards increasing one, design cannot be treated alone as a source of competitiveness. As it is apparent, it requires a combination of certain parameters and criteria. However, especially from the external perspective, where relationships with customers, network engagement and management of customers come into play, design impact on them is less traceable than that on internal product, service or process peculiarities and related activities, such as development and exploitation (innovation).

Table 2. Design Domain and Competitiveness

Uniqueness of your product	+++
Production / servicing process in SME	++
Marketing activities and outputs	++
Branding activities and brand	+++
Design is treated as important source for competitiveness of SME	+++
Innovation process	+++
Capacity for innovation	+++
Cooperation and links with customers / clients	++
Links with supplies	+
Networking and internationalisation	++
Design Domain's Magnitude	Average moving towards Essential

Source: compiled by the author

Design as A Domain for Smart and Sustainable Growth

It is clear that design role as enabler for innovation, competitiveness can be underpinned on entrepreneurial level, where design is driving force for all applicable interactions and transactions. The author argues that smart and sustainable growth can evolve and be sustained when assuring balanced product, service or process development process. Being competitive does not automatically implies being smart and growing in a sustainable way. Sustainability is a very broad concept that can be delineated through intertwining economic, environmental and social layers of performance (Cliberti *et al.*, 2008, p. 1580; Seuring and Müller, 2008, p. 456). Sustainable enterprise, as the case enterprise from Germany shows, should comply with tenets, such as social responsibility, environmental awareness, etc. The aspects of sustainability are gaining more attention as a response to the current economic challenges, increasing negative footprint on environment and social setting, globalisation and demographic trends, etc. In fact, sustainability evolves through value creation and ensuring consistent value chain performance, i.e. value proposition for all involved actors. In addition, sustainability embraces aspects of labour, environmental standards, etc. In this regard, values are affected in terms of social, environmental or labour-related settings and through two key functions within the value chain, i.e. rule making and rule keeping.

Sustainable thinking and acting, however, are not ultimate preconditions for smart growth. The researcher claims that sustainable and smart growth emerges from smart combination. As the enterprise evidence suggest, design can influence sustainable enterprise growth, however, to a different extent. In the particular case study, design role is likely to vary when all the key parameters are measured in the same paradigm – impact of design for the enterprise, as the Table 3 below reveals.

Table 3. Design Domain and Smart and Sustainable Growth

Business performance	+
Integration of internal organisational resources and capabilities and their use	++
SME's competitiveness	+++
Level of innovativeness and innovation generation	+++
SME's business growth	+
Design Domain's Magnitude	Average moving towards Essential

Source: compiled by the author

With regard to the data displayed it may be argued that understanding design role for SMEs growth is not well revealed yet both on the research and practice level in the context of Industry 4.0. Paradoxically, although the enterprises highly recognises the role of design for innovation, which is seen the heart for competitiveness and

growth, the impact of design for growth remains underestimated. The reasoning behind this might also lay in the fact that small enterprises have not clearly linked innovation to competitive business strategy yet or do not possess necessary command how to do this. The decisions are taken less deliberate, it might be argued. Another reason refers to the bare fact that small enterprises are just developing and might have not established business growth perspective yet. Business performance indicator can be interpreted in a similar way, which principally yields internal and external business performance expressed through the costs and revenue structures, all enterprise building blocks, such as operational, financial model, customer and process perspective.

Taking the future perspective of the given enterprise into account, the evaluation pattern looks similar. Design enjoys the highest rank in terms of its potential for future enterprise business within the parameters of innovation and competitiveness. Essentially important in the context of Industry 4.0 becomes efficient resource employment and their utilisation, which share the same position for the given enterprise with the prior ones. For the given enterprise, design will also be crucially important in the future in the array of employees, industrial manufacturing and servicing, whereas economic competitiveness and business growth will be placed far down the business agenda and strategic enterprise orientation modelling.

6. Discussion

Industry 4.0 related discourses are saturated with ‘smartness’, which should help in achieving this goal, particularly, boosting productivity and value added of industries and stimulating economic growth, for instance, through smart products and services (Schmidt *et al.*, 2015; Porter & Heppelmann; 2014), smart objects (Atzori *et al.*, 2014), smart machines and factories (Kagermann *et al.*, 2013), smart manufacturing and industry (Dais, 2014; Davis *et al.*, 2012), smart spaces (Leminen *et al.*, 2012) or smart cities (Letaifa, 2015). It is a smart way of thinking and acting that can be expressed in the ecosystem via smart economy, smart people, smart governance, smart mobility, smart environment and smart living (Giffinger *et al.*, 2007; Mačiulis, Tvaronavičienė 2013). Further six principles can be applied to implement ‘smartness’: interoperability, virtualization, decentralization, real-time capability, service orientation and modularity (Hermann *et al.*, 2015, p. 3). Smart growth implies creation of internal, aligned, self-reinforcement system, which integrates effective leaders, engaged employees, continuous-improvement enterprise culture, experimental learning process including measurement systems and reward policies that drive growth (Downs, 2005; p. 368; Hess, 2010, p. 75).

The principal value of Industry 4.0 lies in providing industries and thus enterprises with specific value implying innovation, competitiveness and growth within the entire ecosystem – operational, strategic and socio-environmental (external) dimension, e.g. through increased flexibility, mass customisation, speed in product / service design and manufacturing, improved product quality, increased productivity, integrated customers and higher customer satisfaction or proximity of location to customers (Davies, 2015, p. 2ff; Mejttoft, 2011, p. 672). This, in turn, facilitates not only smart, but also sustainable thinking and acting. In sum, all these principles are encompassed within a business model providing a smart value, where industry and enterprises gain competitive advantage and are able to grow based on their innovativeness, capabilities for product, services or process designs that meet customers’ needs and assure quality and satisfaction thereof.

In Industry 4.0, there is a shift in the paradigm of value creation and value capturing. It is not anymore enough to create value by identifying customer needs and producing state-of-the-art products. It is usually a web-based services that users access through a product (Ferber, 2013, p. 2) and generate income (Carruthers, 2014, p. 5). Instead, the focus shifts towards value creation based on customer experiences and value capturing, i.e. monetisation of customer value in the digitised connected spaces, including value-added services. Indeed, there is a growing concern that the classical generating strategy model as developed by Porter building upon differentiation, cost leadership and focus is not sufficient any longer, as these indicators can be supplement, but not solely used as exclusive ones. It is more that they can reinforce value creation and capturing (Hui, 2014, pp.

4-5; Porter, 1985, pp.12ff). However, the combination of both is needed – strengthening products, their differentiation, supply chains, human resources, brands as well as related services. As a result, value creation and capturing should be scrutinised from both manufacturer and customer / consumer perspective. Indeed, this is a special endeavour to be kept in mind when dealing with Industry 4.0, highly digitalised world and intensive interactions inside and outside the enterprise.

Table 4. Design as a Strategic Domain for Value Creation

Design integration through strategic value proposition		
Σ Design as an integrator and innovation enabler	Design deployed and exploited on corporate operational and strategic level	
Form of design integration	Operational indicators	Strategic indicators
DESIGN AS: Resource Knowledge Information Meaning Source of competitive advantage Competence Resourcing, organisational coordinative, protective and innovative capability Coordinative capability Networking capability	⊕ Aesthetic appearance (form)	⊕ Differentiation
	⊕ Functionality in the value chain (e.g. manufacturing specific product/service) to be validated (e.g. through technology, cost, etc.)	⊕ Productivity ⊕ Strategic flexibility
	⊕ Manufacturability (product/service as a result of design /creativity process from problem/idea to commercialisation on the market)	⊕ Positioning ⊕ Resource efficiency ⊕ Efficient productivity
	⊕ Integrity (using design to intertwine aesthetic, technological, business, social, environmental resources and capabilities)	⊕ Differentiation ⊕ Strategic flexibility ⊕ Customer/user satisfaction
	⊕ Durability (product/service effectively and efficiently used over longer time)	⊕ Positioning ⊕ Customer/user satisfaction ⊕ Differentiation
	⊕ Quality (product/service excellence in use and recognition by customers/users)	⊕ Positioning ⊕ Differentiation ⊕ Customer/user satisfaction
	⊕ Sustainability (product/service functionally reusable, recyclable, material-saving, ecological, clean)	⊕ Resource-efficiency ⊕ Differentiation ⊕ Positioning ⊕ Strategic flexibility ⊕ Societal critical mass
	⊕ Usability (user-friendly, safe, reliable, individually customised, etc. product/service)	⊕ Customer/user loyalty and satisfaction ⊕ Positioning ⊕ Differentiation

Source: compiled by the author

Design can create extensive value – would it be smart manufacturing, smart products and services or other smart solutions for customers and consumers. Impact of design within industry 4.0 practices can be clearly linked through perceiving design as a source of competitive advantage, knowledge, information, resource, capability and innovative and creative process. As a common thread serves value proposition, activities of value creation and processes of value capturing and exploitation. Indeed, the value creation includes resources, dynamic capabilities and processes required to deliver the offering – starting from partner/supplier relationships to sales channels. Value capture comprises the underlying cost structure and revenue formula, which decide about profitability and economical sustainability (Burmeister *et al.*, 2015, p. 5). Design, which has been perceived as knowledge, can be strategically deployed and exploited for product/service innovation. Strategic acting of design within the business array can be delineated as a critical dynamic collaboration across operational and management practices of organisations or companies successfully utilising design capabilities. For this, design integration for innovations resulting in value proposition on corporate level might be showcased as in Table 4.

Table 5. Design as A Strategic Domain for Value Creation in Industry 4.0

Design integration in industry 4.0					
Integration domains industry 4.0	Manifestation / dimension	Performance impact	Operational indicators	Strategic indicators	Enabling, creating and implementing technologies
Industrial manufacturing Healthcare Sustainable mobility and transport Energy efficiency Clean technologies Service sector Customer/user engagement	Industrial design (product) Service design (services) Design as a innovation process Design as an integrated creative process	Operational efficiency Economic efficiency Environmental efficiency –e.g. travel/carbon footprint / source / energy reduction Social efficiency – individual customisation, user acceptance, liberalisation / democratisation	Aesthetic appearance Functionality Manufacturability Integrity Durability Quality Sustainability Usability Reliability	Differentiation Positioning Strategic flexibility Resource efficiency Customer/user satisfaction Value creation Competitive advantage Predictability	ICT – computers, servers, software, Internet, WiFi, EDI, etc. IvT – modelling, simulation, visualisation, rapid prototyping, 3D printing OMT – design and production & coordination and networking technologies (e.g. computer-aided design tools, CNC, MRP, etc.

Source: compiled by the author

In the context of industry 4.0, such strategic indicators of design enable clear strategic opportunities advocated by scholars and practitioners: competitive strength, flexible manufacturing, individual customised products and services, innovative business models, new working and collaboration ways, resource-efficiency (production on demand), production at a place of use or in the market and user engineering through his integration in development process (Bartevyan, 2015, p. 2). Indeed, innovation, and thus design, as showcased above, can beat on the market with same value enablers (Francis and Bessant, 2005, p. 172ff). When it comes to design integration areas in the course of Industry 4.0, there exist different classifications and specifications of key technologies and domains of their application (Dujin *et al.*, 2014; Bechtold *et al.*, 2014; Blythe, 2014; etc.). Areas of application can be distinguished based on such criteria as networked systems; intelligent products/services; smart solutions, users; key enabling technologies; key economy sectors (transport/logistics, energy, mobility, maritime, environment, healthcare, business, insurance and finances, creative industries); industrial applications (e.g. advanced manufacturing); social and virtual networks and culture and social interactions.

Yet, within industry 4.0, design integration and exploitation for value creation is considered impossible without key enabling technologies. These are likely to be essential for innovation, and thus for design integration creating strategic value. Key enabling technologies allows design integration and exploitation within product/service innovation processes through integrating all key stakeholders – companies, suppliers/partners, customers, users and policy decision makers (Whyte *et al.*, 2015, p. 13). Within innovation processes, such technologies play crucial role for innovations, as they make innovation and thus design process more accurate, efficient, provides more activity/action room, time saving and cost efficiency, result-orientation (product/service innovation), resource efficiency, experimentation and sophistication (Dodgson *et al.*, 2008; p. 5; Thomke, 2001, Schrage, 2013; p. 211ff; Debackere and Looy, 2003). They also make sharing between and coordination of stakeholders and coordination of actors in innovation process simpler. Such design enabling technologies are used both internally and externally – corporate and market (community) level as well as in the economic and social context, characterised by shift away from manufacturing industries to services in developed economies. This, in turn, is stimulating innovations leading towards improved value, quality and experience in consumption. Economically, it is also increasing productivity and profitability in their supply (Dodgson *et al.*, 2008; pp. 5-6).

Fig. 1. Business Modelling for Design Integration within Industry 4.0 Landscape

Learning & Growth perspective	Target: increasing number of innovations driven by design Measure: number of innovations and design integration	Target: cost efficiency in the long-term Measure: numerical data of achieved cost efficiency through design-driven innovation processes	Target: Smart & sustainable organisation readiness; new product, service or process portfolio integrated with technology; producer-customer paradigm Measure: design integration within internal business practices, vision and strategy; new growth prospects and new customers	Target: customer retention through design and sense making Measure: customer loyalty; exploitation of innovation products, services or process on the market; sustained co-creation; service proposition for customers attached to the product or process
	Target: innovation process efficiency & effectiveness Measure: Parameters of efficiency & effectiveness proving process simplification, streamlining and acknowledgement internally, innovation creating, enabling and implementing technologies	Target: cost efficiency providing competitive advantage for enterprise Measure: number of key indicators achieved in terms of costs reduction, resource efficiency	Target: design-driven competitive advantage sustained Measure: number of indicators proving competitive advantage for enterprise by design; improved technological base enabling innovations and user interactions	Target: social responsibility and environmental awareness assured by design integration Measure: number of indicators achieved on sustainability level, including customer experience on design integration
	Target: integrated design process Measure: integrated design process within product, services, process development; supply & value chains	Target: cost efficiency; cost reduction on operational and strategic level Measure: reduced costs through structured innovation process adopted driven by design	Target: launch of product, service or process innovations Measure: number of product, service or process innovations developed and launched	Target: product, service or process innovations exploited on the market Measure: customers / end-users engaged into innovation service co-development and evaluation; number of customers / end-users platforms related to launched service / product
Operational / process level Financial level Strategic level Socio-environmental level				

Source: compiled by the author

Conclusions

Design integration and tracing its potential for value creation needs cross-cutting perspective. Establishing cross-linkage between design and business domain to innovation in Industry 4.0 landscape allows forging design-driven strategic orientation of enterprise as well as proposes background to generate business models for enterprises aiming to catch up with Industry 4.0 and to comply with its tenets – operational efficiency, competitive excellence, smart and sustainable growth. This research contribution yields that design is a sound source of value creation through innovation, competitiveness and growth. Creating value through design integration can become heart of businesses that set out not to be innovative, competitive and growing, but using design to move towards uniqueness and smart and sustainable competitive strength. Design as a driving force for value creation makes it hard for competitors to imitate business model and strategy. Design integration as key ‘ingredient’ in business model within Industry 4.0 comes up with new perspective crossing boundaries of business and technological array. The conceptual common thread needs to agglomerate concepts supporting this smart and sustainable growth. The author argues that interlinking profound concepts from the strategy, management and firm-based literature with that of the strategic design related concepts in the paradigm of European economic development could support business excellence in European SMEs. In fact, the present research, which is complementary to the first attempt to perceive and track design integration for innovations within Industry 4.0, reveals the positive link and provides a potential model for small enterprises to proceed.

Deepened observations of entrepreneurship practices within Industry 4.0 domain support the scholarly justification of positive design impact for innovations and extend the perspective. If design integration yields the power to develop and exploit innovations being a driver for competitiveness and growth, it is rather also the case that design will result in value creation. Achieving innovation, competitiveness and growth is smart strategic orientation of an enterprise. Design integration and design management practices might affect not only the innovation dimension of entrepreneurship but also the entire enterprise ecosystem and value creation emanating from design integration within business practices. It is not enough to rely on service design as a business model. There is needed integrated perspective on design perception within Industry 4.0 and smart enterprise in order to remain sustainable, resource-efficient and smart. Internal and external perspectives need to be combined, as the proposed business model implies. The empirical data justify this need and showcase the importance of design integration for enterprise innovation capacity, competitiveness and smart growth.

Nevertheless, the research results recognise affordance to quantify the positive design impact within the business model application in the subsequent research step. Particularly, this is evident in the case of design integration and its potential for small enterprise within the parameter of smart growth. The future research impetus is therefore driven by the fact to generalise the positive research implications with empirical observations. A number of enterprises should be analysed in this context from being very small to bigger ones. Further, empirical data need to showcase perspectives of different enterprises performance across the networks, particularly, focusing on the increased connectivity, intensified interactions and stronger focus on customer and end-user logic.

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