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SUSTAINABLE BUSINESS MODELS AND STRUCTURES FOR INDUSTRY 4.0

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Abstract. EU industry accounts for 15% of European value added and the industrial sector plays the role of a key driver for research, innovation, productivity, job creation and exports. One important measure in order to stop the decline of Europe’s global industrial position is represented by Industry 4.0 aiming for the implementation of smart production and logistics. Industry 4.0 touches the entire supply chain comprising product design and development, operations management and logistics and by doing so new business models and structures are required.

Currently, companies start to practice first steps in 3D printing, production in networks and smart logistics and begin to develop new organisational structures and business models to benefit more from the opportunities that the new technology offers. Empirical evidences of successful companies reveals that the new business models are oriented rather on service design, open innovation and network approaches than on the traditional concepts of industrial enterprises. Consequently, traditional industrial companies have to rethink and to renew their business structures and models in parallel with the ongoing implementation of Industry 4.0 to use the new opportunities.

The main focus of Industry 4.0 is laid on the fusion of the virtual and the physical world so that also new concepts are required for managing information and business administration tasks in the context of Industry 4.0. One big step towards the implementation of such a concept is embodied by the Estonian concept of “e-Residency”, which might be an appropriate e-business approach especially when taking into account the needs of internationally operating entrepreneurs and SME’s.

The paper addresses the research question of how new and sustainable business models and structures for Industry 4.0 might look like and in which direction existing traditional business concepts have to be developed to deploy a strong business impact of Industry 4.0. By focussing on the needs of entrepreneurs and SME sector the paper also discusses why e-residency might be the appropriate concept in the context of Industry 4.0.

Keywords: Industry 4.0, Business Models, Organisational Structures, e-Residency

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1. Introduction

After two decades of decline, manufacturing and re-industrialization enjoy a renaissance on the Western economic agenda because politicians, business leaders and scientists recall the role of the industrial sector as a key driver of research, productivity, and job creation (Tvaronavičienė 2014; Rezk *et al.* 2015; Travkina, Tvaronavičienė 2015). Industry generates 80% of the EU's private innovations and 75% of its exports (Travkina 2015). Despite these facts a view into the statistical figures reveals that the global share of European manufacturing value added dropped from 36% in 1991 to 25% in 2012 (Veugelers 2013; Heymann and Vetter 2013). Currently, EU industry accounts for only about 15% of the total gross value added and so, consequently, the weakening industrial base in the EU is threatening its wealth and future innovation performance (Eurostat 2015; Tvaronavičienė 2014). Within the last years, many manufacturing initiatives have been started in different parts of the world, directed at re-establishing and regaining a significant industrial share in the economy. A very promising approach seems to be the fusion of the virtual and the real world, i.e. the linkage between internet and manufacturing leading to concepts of smart manufacturing and logistics. Smart manufacturing aims to develop cyber-physical systems (CPS) and dynamic production networks in order to achieve flexible and open value chains in manufacturing of complex mass customization products in small series up to lot size 1 (Ramsauer 2013).

In Germany, the most important industrial EU country with an industrial gross value added of about 30%, this approach has been called "Industry 4.0", whereas comparable initiatives outside Europe are called "Advanced Manufacturing Partnerships" for the USA or "Made in China 2025" for China (Dujin *et al.* 2014; Kagermann *et al.* 2013). Meanwhile, since July 2015, the German minister of economics, Sigmar Gabriel, and the Chinese minister for industry and ICT, Miao Wei, signed an agreement about German and Chinese cooperation in the field of "intelligent manufacturing" including the German Industry 4.0 activities (Handelsblatt 2015). When analyzing the objectives of Industry 4.0 it turns out that Industry 4.0 has even higher ambitions, which are going beyond the development and use of cyber-physical systems and dynamic production networks. As Kagermann *et al.* (2013) pointed out Industry 4.0 aims also for energy and resource efficiency, increased productivity, shortening of innovation and time-to-market cycles together with a horizontal and vertical integration through value networks and an end-to-end digital integration of engineering across the entire value chain. Internet-linked production facilities and networked manufacturing systems open up a machine-to-machine communication and interaction, called M2M, which allows to name, identify and trace single products during their whole creation process and later on during their life time, which generates new perspectives for the entire supply chain including product design and development, operations management and logistics (Bauer *et al.* 2014; Brettel *et al.* 2014). In this sense, Industry 4.0 represents nothing less than the fourth industrial revolution, comprising 3D printing, big data, Internet of Things and Internet of Services, i.e., all of the ingredients needed to facilitate smart manufacturing and logistics processes (Kagermann *et al.* 2013).

Consequently, the implementation of Industry 4.0 is linked with the hope to bring back competitiveness in the manufacturing and high-tech sector to Western countries. But the successful realisation requires R&D activities and progress in eight key areas comprising standardisation and open standards for a reference architecture, the management of complex systems, the delivering of a comprehensive broadband infrastructure for industry, safety and security issues, work organisation and work design in digital industrial age, specific training and continuing professional development, an appropriate regularity framework as well as resource efficiency (Kagermann *et al.* 2013).

Until now smart production is still a concept related with many open questions in the eight key areas but the Western industrial countries are equipped with a sufficiently high innovation potential, a sophisticated ICT infrastructure, and highly qualified workforce so that the upcoming standards, technical solutions as well as appropriate and sustainable business structures and models might be developed (Spath *et al.* 2013). But the R&D needs for Industry 4.0 go far beyond sophisticated production expertise, what is also required is especially ICT related knowledge covering cyber security, e-commerce and e-government (Bileišis 2014; Grubicka, Matuska 2015; Štītīlis, Klišauskas 2015).

Since Industry 4.0 emphasises cyber – physical aspects there is a special need for new concepts for the managing of information and business administration tasks in the context of Industry 4.0, safeguarding the integration of the SME sector into international supply chains together with new business models, which are stressing more cooperation and knowledge sharing aspects (Prause 2015a). Such a “Business 4.0” concept, i.e. a concept for the management of information streams and business administration issues within supply chains in the context of Industry 4.0, focussing on the needs of internationally operating entrepreneurs and SME’s has been recently launched by the Republic of Estonia under the title of “e-Residency” (e-Estonia, 2015). Estonia is the first country to offer a transnational digital identity available to anyone who is interested in administering a location-independent business online allowing to manage the related e-business and supporting the new business models of Industry 4.0.

The empirical measures of this paper combine desk top research, expert interviews and case studies, which have been executed within the Europe projects “DesignSHIP” and “Crossing Boundaries” between 2011 and 2015. The discussed business models and structures have been investigated and empirically analysed in companies operating in 3D printing, production in networks or smart logistics.

2. Value Chains and Business Structures of Industry 4.0

In his value chain theory, Porter (1998) stressed the importance the specific profile of activities as a source for the long-term competitive advantage of a company and he used the term company activities synonyms with business processes comprising supply chain processes due to the cross-company character of value chains. Today’s value chains, often evolved over longer periods, tend to be relatively static and the supporting ICT systems exchange information along the value chain via a variety of interfaces but usually there is no global overview from the product perspective that has been manufactured and distributed (Brettel et al., 2014). M2M technology of Industry 4.0 together with internet–linked production facilities and networked manufacturing systems allow to identify and to trace single products during their entire life-cycle and even more because in industry 4.0 it becomes possible for products to organise and choose their own way through the production and related logistics processes (Bauer *et al.* 2014). The pilot project “AMATRAK” at ISL Bremen showed that self–guided container transportation systems are feasible where the containers are able to choose and book suitable and optimal transportations means according to their own needs (ISL 2015). Thus Industry 4.0 leads to new supply chain paradigms based on complex and intertwined manufacturing networks with changed roles of designers, physical product suppliers, clients and logistics service providers.

As a consequence, Dujin *et al.* (2014) pointed out that Industry 4.0 value chain will undergo the same fragmentation, which have emerged already before in other monolithic industries like music or the media and that this fragmentation comes along with low entry barriers for SMEs, i.e. the “slicing up” of the aggregate value chains, as well as the entry of new countries bearing low labor costs (Belussi and Sedita 2010). Consequently, Industry 4.0 will deliver greater flexibility and robustness and Industry 4.0–related value chains will be built of flexible and adaptable business structures, which possess the permanent ability for internal evolutionary developments in order to cope with a changing business environment (Koether 2006).

Suitable business structures have been coined by Warnecke (1997) already in the 1990’s in his concept of a fractal company. A fractal enterprise is characterised by self-similarity, self-organization, self-optimization, goal-orientation, and dynamics as winning attributes of flexible and adaptable manufacturing organizations. Warnecke (1997) stressed also intrapreneurship as a success factor of fractals and pointed out that fractal organizations are linked via high performing ICT systems and they decide individually about the type and scope of access to their data. These fractals enjoy the five properties, which have been pointed out by Warnecke and these five properties are also compatible with the discussed characteristics of the Industry 4.0. The process of building a fractal structure is based on relations between material, personal and information whereby inside a fractal structure these relations are closer and more intensive than on the outside, so that fractal building is comparable to mathematical cluster process based on the relationship and weights of the resources. In the context of Industry 4.0 due to the increasing importance of information, internet, cross–company interconnectivity in

operations and supply chain management the weight of information gains significant importance in the clustering process whereby the supply chain comprises the entire product life-cycle process including product design and development, operations management and logistics (Koether 2006).

Consequently, the internet access points within a supply chain as well as the cross-company information interfaces together with their surrounding form structures of high internal interaction and exchange of resources, which can be considered as fractals in the sense of Warnecke since they are built according to the principle “join the parts around an information access point of equal information level” and they represent timely, limited, stable, optimal structures that are changing their shape and structure according to their local needs (Prause 2015b).

Thus coherence between the fractal concept of Warnecke and sub-organizations in Industry 4.0 can be identified as well as another observation of Warnecke stating that the information intensity and complexity inside a fractal is higher than between fractals. Consequently, also the workers in a fractal represent information processing individuals whose required skills and knowledge levels have to be relatively homogenous and strongly related to the used information quality of the fractal (Spath *et al.*, 2013; Kagermann *et al.* 2013). Meanwhile many scholars have been inspired by the fractal concept and developed extensions of the fractal model in the direction of flexible relationship networks built of autonomous and interdependent manufacturing fragments (Canavesio, Martinez 2007; Shin *et al.* 2009). Such organizational expansions bring new responsibilities, new branches and growth, which gives room for the integration of information and manufacturing structures in the context of fractals, especially paving the way to the alliances of the fractals as they work together (Panetto, Molina 2008; Raye 2012). Canavesio and Martinez (2007) formulated another viewpoint on fractals by considering a fractal company as a multi-agent system, where each fractal has the ability to observe its environment and make decisions based on the feedback.

The case study of a very successful Estonian production company for functional maritime wear with global operations shall shortly illustrate the potential of a fractal approach and that already nowadays fractal concepts have captured the interest of business life. The management headquarters of the company are located in a rural area in Western Estonia whereas the company operates in highly developed foreign markets like Germany, Sweden and UK. The business operations are distributed all over the world comprising global sourcing mainly in Europe and Asia, German R&D activities, cutting and production of components in Estonia, sewing in Ukraine of the final products and sales activities outside Estonia. The local units of the company benefit of the smart specialisation advantages of the involved regions and the company units enjoy all characteristics of fractals, i.e. they are self-similar, self-organizing, self-optimizing, goal-oriented, and dynamic, and even if they are legally independent they are organizationally linked. This linkage of the company fractals is realized by Internet, common goals and standardized trans-fractal processes, which are fixed and illustrated by multi-media process documentation including e-learning tools that act as blueprint for the business processes in a fractal and the interfaces between the fractals. By doing so the company was able to become the European market leader in maritime functional clothes and showed that Industry 4.0 concepts have been tested successfully in niche markets already before Industry 4.0 reached the political and economic agenda. More details about the case study can be found in Olaniyi *et al.* (2015).

In summary it can be concluded that fractals can be considered as the new structural and organizational building blocks of Industry 4.0, where the different fractals are connected by related information flows, which control the processes inside and between the networks of fractals. By following Lee *et al.* (2014) this gluing function and the high importance of information in Industry 4.0 will open new business opportunities in the field of big data since every piece in the value chain is related and based on specific data characteristics touching the 4V of big data (IBM 2015; Mayer-Schönberger, Cukier 2013).

3. Parallels between Industry 4.0 and Green Transport Corridors

On European level an increasing number of initiatives have been started to speed up the shift towards greener and more efficient freight logistic solutions in Europe. This development process has been spurred by the Freight Transport Action Plan from 2007, the Green Paper on TEN-T from 2009, as well as the TEN-T Policy Review 2011 and the EC White Paper on “A Sustainable Future of Transport” (FTAP 2007; COM 2011). Green transport corridors are defined as transshipment routes with concentration of freight traffic between major hubs and with relatively long distances of transport marked by reduced environmental and climate impact, while increasing safety and efficiency with application of sustainable logistics solutions (COM 2011). The transport within green transport corridors is based on inter-modality, powerful logistics hubs, specific organisational frame conditions and advanced ICT-systems improving traffic management, increasing efficiency and integrating better the logistics components of such a corridor.

In this sense green transport corridors can be considered as smart logistics and transport solutions and as Prause and Hunke (2014) pointed out openness, transparency, fair and harmonised access regulations as well as co-operation aspects are common characteristics for the green transport corridor concept. Prause and Hunke continued by identifying a list of important ICT-frame conditions of green transport corridors comprising of open architecture, orientation on standards, focus on inter-operability and co-modality, independence of technology as well as the creation of a fair and balanced access of SMEs. Hanisch *et al.* (2016) found that green transport corridors and their frame conditions lead to governance and business models, which are closely linked to cooperative business models embracing openness, fair and balanced access as well as cooperative interaction of large firms and SMEs in networks. All these topics are also dominating the discussions concerning “Industry 4.0”. A recently published survey about the “prospects for Industry 4.0” comprising 278 manufacturing companies brought to light that standardisation, new business models, a regulatory framework and new concepts for process and work organisation were mentioned among the most important challenges of Industry 4.0 (BITKOM *et al.*, 2013). In addition to this, Kargermann *et al.* (2013) stressed the need of new business and partnership models as crucial for the success Industry 4.0 and they continued by stating that these new business models should be more geared towards meeting individual, last-minute customer requirements, enabling SMEs to use services and software systems that they are unable to afford under current licensing and business models, providing more solutions for dynamic pricing by taking into account the customers’ and competitors’ situations as well as facilitating the quality of service level agreements (SLAs), which are embracing more networking and cooperation aspects between business partners compared to now. This new emphasis of cooperative business models in the context of Industry 4.0 will ensure the fair distribution of potential business benefits among all the stakeholders in the value chain.

In addition to that, a closer view into the agendas of Industry 4.0 as well as into the frame conditions of green corridors display strong emphasis on safety and security issues in both concepts. These security topics are related to data security as well as to process and functional security. Finally, Kargermann *et al.* (2013) demanded the integration of environmental issues into the regulatory framework of Industry 4.0 in order to spur green business models and establish sustainable business networks that are upheld collectively by the partners. In this sense Industry 4.0 and the concept of green transport corridors share many common business features including openness, standardization, sustainability, cooperation and networking concepts as well as the use of smart technologies comprising internet technologies. These strong parallels between green transport corridors and Industry 4.0 are supporting the exchange of business concepts and models between both topics. Since the theory of green transport corridors enjoys a slightly longer history than the Industry 4.0 approach some points of the regulatory framework of green transport corridors can be transferred into the Industry 4.0 world like the frame conditions for integrated ICT-systems (Prause, Hunke 2014). Additionally, new business models or structures stemming from one of the two topics bear the potential to deliver suitable solutions in the other research topic. The scientific discipline integrating both topics represents the theory of supply and value chains since Industry 4.0 as well as the green transport corridors are based and dealing with smart business operations and logistics so that holistic business concepts might be expected from supply chain management.

4. Business Models for Industry 4.0

Business models describe rationales how companies create, deliver and capture value and the process of constructing a business model is part of the business strategy (Hummel et al., 2010). The importance of business model comprising the identification of strategic supply and demand drivers, macroeconomic environment, megatrends, the level of innovation, business sophistication, technological readiness, financial market development, labour market efficiency, hard/soft infrastructure has been outlined and mentioned in a range of scientific publications and research papers (Eckert 2014). Osterwalder and Pigneur (2010) identified nine building blocks that make up a business model, the so-called “Business Canvas”, which can be considered as an example of an operative business model approach comprising nine elements: customer segments, value propositions, channels, customer relationships, revenue sources, key resources, key activities, key partnerships and cost structure.

Since Industry 4.0 embraces “networked manufacturing”, “self-organising adaptive logistics” and “customer-integrated engineering”, suitable business models will primarily be embedded in highly dynamic business networks than restricted to a single company. Consequently, new and sustainable business models have to ensure fairly shared business benefits among all stakeholders in the value chain and might be more complex, open, collective and evolutionary than the existing ones. Furthermore, they have to facilitate innovation, product development, financing, reliability, risk, intellectual property and know-how protection in a network environment. These considerations lead to different business areas for new business models.

4.1. Open Innovation Models

Today, innovation is increasingly complex, fast, interactive, and requires the access to external and internal knowledge in order to develop new or significantly improved good or service, process or new marketing method, new organizational methods in business practice, workplace organization or external relations (Chesbrough 2003; OECD/EC 2005; Hoffmann, Prause 2015). Firms acquire knowledge from different sources, actors and geographical locations, combining it with internal knowledge and competences. This innovation approach is in line with the internet and network orientation of the Industry 4.0 concept and it embraces collective concepts in innovation, especially all kinds of open innovation thinking. Following Bartl (2008), open innovation is referred to as a concept, which underscores the way of going beyond the corporate boundaries, i.e. an active strategic deployment of environmental clout or external factors of influence to increase its own innovation potential. Crucial determinants of such concepts are the shift from the industrial society to the network-based knowledge and communication society like it is facilitated in Industry 4.0. As a result, innovation occurs and ideas are generated in such a society through the interactive creation of value.

Prause and Thurner (2014) pointed out how developments in communication technology have enabled new forms of user integration in the innovation processes and how virtual communities, communities of practitioners and living labs can be used as a powerful tool to safeguard user oriented and accepted new technologies. This development recognizes cluster aspects as well as the complexity and interdisciplinary of new R&D fields related to sustainability and multimodality and can be applied in the Industry 4.0 value chain with the targeted ICT infrastructure. Collaborative innovation approaches integrate the SME sector with the complex open innovation approaches, where the access points for open innovation are the product design and development fractals in the supply chain. The underlying business model in open innovation activities is related to IPR issues. Hoffmann and Prause (2015) highlighted that product-related data provided by users in virtual communities in form of comments, feedbacks, and recommendations is already today an essential source of innovation and that these data are basically freely accessible on the web endangering a company’s legal position in patenting due to the risk of lack of novelty. So there are various intellectual property issues protecting the user’s contribution, which are often not taken into account by companies making use of the respective data, causing an eventual infringement of protected rights and therefore the sustainability of the company’s innovation policy.

4.2. Service Design Models

Industry 4.0 paves the way for new business models covering also new sustainability concepts of product life cycles. Derived sustainable business models can deliver marketing advantages for sustainable products even if they are related with higher prices. Prause *et al.* (2012) discussed the case study of a multiple useable teapot warmers developed by the Sustainable Design Centre in Berlin in order to demonstrate a new service–design oriented business model. The product “teapot warmer” enjoys already now a lot of characteristics of Industry 4.0 because it is built in small series, consists of high quality steel parts and the full life-cycle of the product is traceable since the manufacturing takes place by craftsmen in Berlin and the selling and distribution is mainly realised via internet. The client is able to customize his product according to his specific design requirements and the teapot warmer is delivered in parts via postal mail to the client who only assembles the parts. Compared to ordinary product, the price but also the quality of the sustainable teapot warmer is significantly higher and the big difference to Industry 4.0 is that the manufacturing process is fully realised by persons and not in a network of CPS. Nevertheless the teapot warmer can be taken as a blueprint for a new business model in the context of Industry 4.0 due to the long list of common characteristics with Industry 4.0 as well as the need for developing a sophisticated marketing strategy for the sustainable teapot warmer in order to keep the high–price product competitive.

The Sustainable Design Centre created a new business model based on the idea that the interested client can buy the product for a fixed price including the option to give back the teapot warmer to the producer after a certain time of use. This approach develops further the well-known example of the recycling system of return bottles but now for an entire high–quality product, which is still fully functioning. By virtue of the high quality of the material and the stick-together technology of the product the producer is able to renovate the returned parts and sell them again to the next client with the same business model. Therefore, this particular product integrating design and technology along with its specific business model results in a sustainable product that enjoys a multiple product lifetime and becomes competitive compared to traditional products that are bought and trashed after usage. It was possible to realize this business model only because the whole product was created and sold by one manufacturer, i.e. from Sustainable Design Centre.

Industry 4.0 opens now up the possibility to implement comparable business models also for complex products with cross-company operations and a complex supply chain due to the involvement of internet-use and CPS, which makes the full production process traceable and transparent so that life-cycle oriented business models like the teapot warmer can be realized also for sophisticated products. Such a business model represents the realisation of a service design concept where the customer does not primarily purchase itself a product but rather buys the service the product or devices is realizing with the consequence that the product design changes into service design (Scheider, Stickdorn 2011). In this sense service design represents sustainable design since not the material product stands in the focus of the business model but the service, which is realized by the product, which poses new challenges since successful service design solutions have to be connected to a strong and coherent brand identity and a smart business model (Kaivo-oja 2012).

4.3. e-Residency for Industry 4.0

The fusion of cyber–world and material world in Industry 4.0 leads to virtual structures in the value and supply chains, which require organisational and managerial tasks for related cross-company operations processes in networks touching manufacturing, logistics and distribution (Sydow, Möllering, 2009). These management tasks are realised and controlled by information flows within the Industry 4.0 networks and they are running parallel to the physical value and supply chain flow (Simchi-Levi *et al.* 2007). Consequently, the physical value streams in Industry 4.0 – related supply chains require an appropriate cyber – platform to be able to control the parallel information streams and to handle the related business administration tasks.

The Republic of Estonia is the first country to offer a transnational digital identity available to anyone who is interested in administering a location-independent business online. This sophisticated form of e-business

is called “e-Residency” and offers a government-issued digital identity and the opportunity to run a trusted company online, unleashing the world’s entrepreneurial potential. The concept of e-residency is in line with ongoing approaches in the context of Industry 4.0 trying to realise the fusion of the virtual and the real world, i.e. the linkage between internet and manufacturing leading to concepts of smart supply chain management

The Estonian ministry of Economic Affairs and Communication initiated recently a study for analysing the pain points for entrepreneurs and SME’s participating in international supply and value chains (e-Estonia 2015). The results of these investigations reveal that the e-residency platform enables SMEs which are participating in Industry 4.0–supply chains to control the information streams of material added value streams of supply chains and to handle related business administration tasks (Figure 1; e-Estonia 2015).

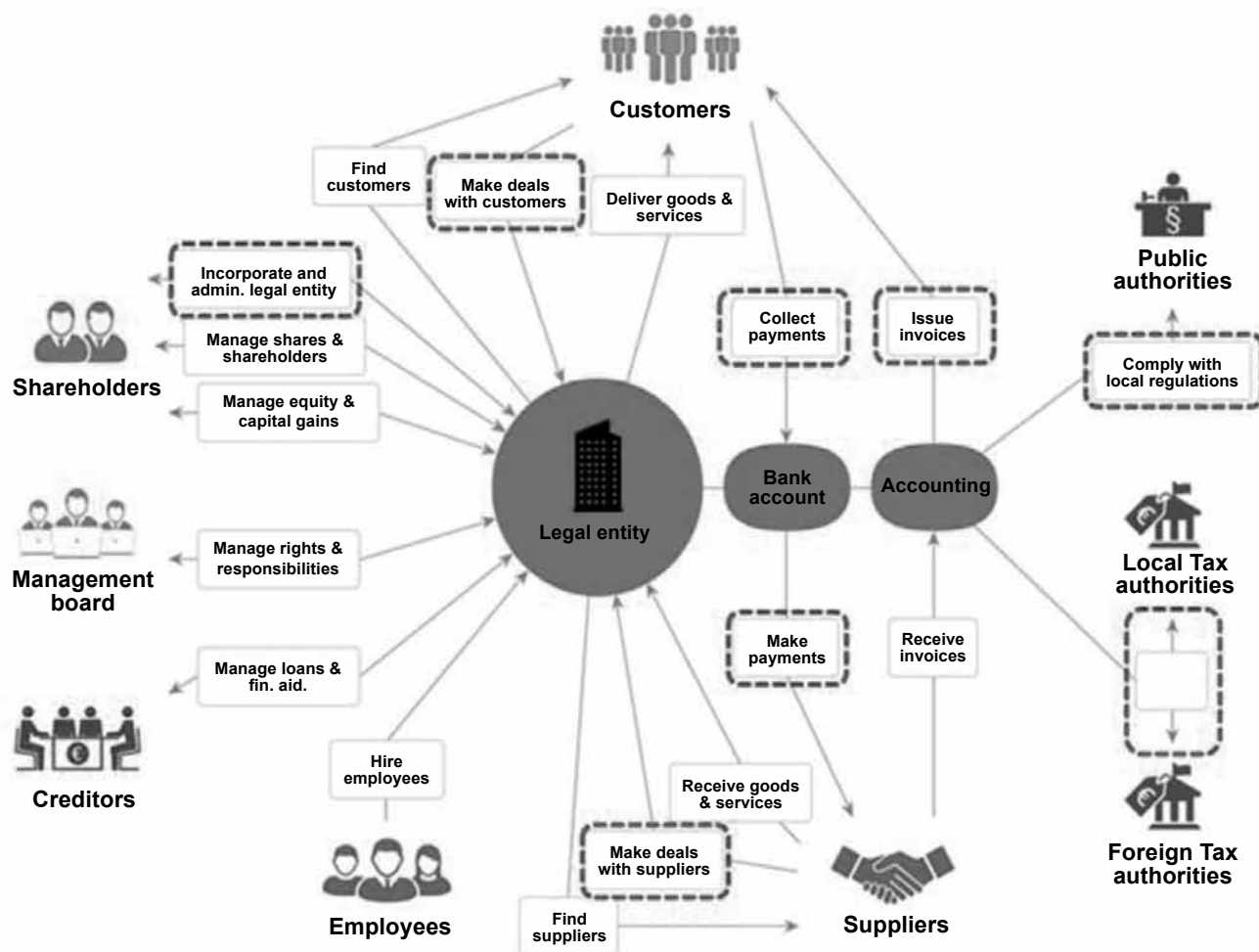


Figure1. Crucial business administration tasks of supply chains for entrepreneurs
 Source: e-Estonia (2015)

Thus, the Estonian e-residency concept can be considered as the fusion of the cyber and business administration world which might play the role of international business administration platform for Industry 4.0 which possesses the potential to spur the evolvement of further international business models in the context of Industry 4.0, especially for internationally operating entrepreneurs and SME’s. As special case one can consider two non-European entrepreneurs from Japan and Mexico who are able to do “remote” business as e-residents via Estonia everywhere in the world by using the e-Estonia platform. The special advantages for both entrepreneurs are that they can use all Estonian e-services and other service offers that even don’t exist in their home countries, they enjoy access to the EU–banking system (SEPA) including the advantage of quick and cheap financial transactions inside EU, contracting and enforcement in a reliable Estonian law system as well as the possibility of a remote foundation of a Estonian holding company including the favourable Estonian taxation

system. As a long term advantage both entrepreneurs are able to achieve an EU-residency after having bought real estate in Estonia. The special advantages for the Estonian side is to develop Estonia via the e-residency to an international business hub with growing service offers for foreign entrepreneurs and investors in the fields of finance, consultancy, accountancy and law services (Prause 2015c).

5. Conclusions

Industry 4.0 aims to create a horizontal integration through value networks with an end-to-end digital integration of engineering across the entire value chain together with a vertical integration and networked manufacturing systems. The new value chains open the way towards complex and intertwined manufacturing networks, which will change the roles of designers, physical product suppliers and the interfaces with the customer causing a fragmentation of the value chain, which have been seen already before in other monolithic industries. Consequently, this process will be accompanied by fragmentation, new structures and new business models.

Internet usage, CPS and cross-company information interfaces in supply chains lead to fractal structures in the sense of Warnecke. These fractals are built according to the principle of “join the parts around an information access point of equal information level” and they represent timely, limited, stable, optimal structures, which are changing their shape and structure according to their local needs. The fractal structures exist already in successful companies and corresponding business models focus on the entire life-cycle of products, on service design concepts and the open innovation approaches. Thus, the new structures in Industry 4.0 are fractals and they represent crystallization point around the internet access point in the supply chain.

This high importance of information opens up new business opportunities in the environment of big data for Industry 4.0 but also in the establishment of new business models. A comparison with the concept of green transport corridors discloses huge similarities of the frame conditions so that exchange of concepts and solutions seems to be fruitful, especially concerning cooperative and network approaches, security issues as well as sustainability aspects. The transparency and traceability of the products during their entire production process and their life-cycle generates new opportunities for business models embracing sustainability, sustainable product design as well as service design concepts. The industry 4.0-related business administration activities might find their suitable platform in the e-residency concept of the e-Estonia.

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