PRODUCTION INNOVATION IN MANUFACTURING FIRMS: THE CASE OF SWEDISH SMES

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Abstract

The manufacturing industry needs to meet the challenges of a rapidly changing society by using innovation while considering other factors such as trends. This paper focuses on three overarching trends: globalization, urbanization, and digitalization. These three major trends together with policies and regulations could be regarded as fierce threats to a manufacturing firm operating in a traditional mature industry. However, this mix could also be viewed as an opportunity for the innovative company to address future market needs and gain competitive advantage. Thus, the aim of this paper is to investigate the production innovation in SMEs by considering the developments in the manufacturing processes as well as the innovation and design process activities of the manufacturing company. Through two case studies in Sweden, this paper seeks to answer how do SMEs operating within the manufacturing sector respond to the sustainability and other emerging trends while innovating in their production processes. This paper helps to understand how these firms are using some of the approaches and strategies to keep the current pace of innovation and sustainability trends.

Keywords: Innovation, Product-service systems (PSS), Sustainability

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1 INTRODUCTION

Companies in the manufacturing industry need to meet the challenges of a rapidly changing society by becoming more and more innovative. Simultaneously, the companies also need to consider other relevant factors such as trends, regulations, and policies which can be important drivers of sustainable innovations (Smith et al., 2010). A clear example of the previous idea is that three overarching trends are currently setting the agenda for innovation initiatives within firms: (1) globalization, (2) urbanization and (3) digitalization (Nordström and Schlingmann, 2014). **Globalization** implies that business is becoming at the same time local and global, sometimes referred to as "glocal" (Svensson, 2001). For the manufacturing firm the consequence is that although customer relations may be local, geographical distances could be large. This provides a rationale for production units to be set up where the manufacturing conditions are most advantageous. Decision criteria can include cost of labour, proximity to logistical hubs or facilities to meet the specific goods distribution requirements, amongst others. Most of these aspects are dependent on the demands and prerequisites for specific products offered by firms. **Urbanization** is the phenomenon of more people moving into cities, which makes employment and attractiveness to places remote from city hubs a major challenge. Megacities, a growing tendency in Asia, are creating new habits and life conditions for the many, successively taking people from poverty to an increasing middle class (Kraas, 2007). **Digitalization** started as a trend since the first computers were developed. In fact, nowadays computers are an integral part of any manufacturing firm along with robotization[1]. These activities in manufacturing firms are a natural investment and a development step rather than a burden in the design of operations.

Altogether, these three major trends could be fierce threats to a manufacturing firm operating in a traditional mature industry. In addition, these trends can create more concern for firms if they are also mixed with the implementation of policies and regulations towards sustainability. However, this mix could also represent opportunities for the innovative company to address future market needs and gain competitive advantage. For instance, some regulations such as the Emissions Trading Scheme can help fostering innovation while developing other sustainable practices (Martin et al., 2014). In line with these tendencies, the focus on services and customer value has been prevailing in the manufacturing industry the last 15 years (Oliva and Kallenberg, 2003). Here, an ever increasing awareness of environmental effects, and efforts to reduce the ecological footprint are built in and enforce these activities, since better use of physical artefacts is a way to spare physical resources while achieving most possible user and customer value (Barrett et al., 2005). This implies a view on the manufacturing process as an integral part of the innovation and development activities of the firm, which is in line with the current trend of designing new offerings with the complete product life-cycle in mind, e.g. product-service systems (PSS). The PSS view encloses user demands and services as integrated parts in the product development process (e.g. see Ulrich and Eppinger, 2000), from idea to realized product (or PSS) in use through the complete product life cycle. Taking the above into account, the aim of this paper is to investigate **production innovation** with cases from small and medium-sized enterprises (SMEs) by considering (1) the innovation in the manufacturing processes, especially from a sustainability perspective and (2) the implications for the innovation and design process activities of the manufacturing company. In particular, this paper focuses on understanding how do SMEs operating within the manufacturing sector respond to the sustainability trend while innovating in their production processes. To answer this question, two case studies were conducted, one at Lindbäcks Bygg a manufacturing SME in the North of Sweden and Automation Småland a partnership of SMEs located in a well-known innovative region of the South of Sweden which provide specialized automation services to the manufacturing sector. Through the description and the initial analysis of the two cases, this paper helps to understand what are some of the approaches and strategies that this type of firms use to keep the current pace of innovation and sustainability trends. The rest of this paper is organized as follows. Section 2 is dedicated to propose the theoretical framework to study production innovation in a contemporary context. Section 3 briefly describes de methodology used to collect and analyse the data. Section 4 presents the detailed results and discussion of the case studies. Finally, Section 5 provides some conclusions, study limitations and recommendations for future research.

[1] Robotization is frequently used as synonym to automation as confirmed in the Merriam-Webster dictionary.

2 THEORETICAL FRAME FOR PRODUCTION INNOVATION

Innovation in manufacturing companies has always been an important research topic but has been investigated under different labels over the years. Some issues appear when we try to separate a technological invention from a successful innovation, the existence of different types of innovations, the distinction between technology push and market pull, and lately the uncertain path of innovation processes considering policies, regulations and trends such as sustainability. Therefore, it could be useful to combine different but known trends driving society, industry and government actions with innovation activities made by firms.

Primarily, in this study a production process is the system of process equipment, workforce, material inputs, work and information flows that are used to create a product or a service (Utterback, 1994). On one side, innovation in product, as a good or a service, is a production or method that improves significantly in technical specifications, components, and materials, software in the product, user friendliness or other functional characteristics. On the other side, innovation in process is the changes in the use of techniques, equipment and software to achieve a specific goal (OECD, 2005). To our knowledge, there are considerable opportunities in researching innovation in production because it has different applications in the industry e.g. the manufacturing sector. Moreover, innovation in production seems to relate new practices inside firms fostering its growth while being sustainable. For instance, computer aided manufacturing will ultimately reduce some of the interdependence between product and process while considering elements such as waste reduction and energy efficiency.

2.1 Policies, regulations and innovation

Industry is constantly changing, and manufacturing firms are modifying their strategies to offer more than products but also related services in order to create value. In July 2009 the European Commission (EU), embraced policies that have emphasized practices towards sustainable development. The EU has taken the lead in the fight against climate change with strategies like the EU emissions trading scheme (Martin et al., 2014). In addition, the EU Sustainable Development Strategy was made to help EU to reach a non-stop development by using resources efficiently, to be able to have prosperity, environmental efficacy, and social unity. The strategy has seven challenges that include sustainable consumption and production amongst other directives. However, it has been known for several years that these types of regulations, policies, and initiatives play a key role in the innovation that happens in companies (Firth and Mellor, 1999). Therefore, a complete picture of what is currently driving sustainable innovation in firms could be by looking at new social trends that are happening worldwide.

2.2 New trends influencing production innovation

Production innovation has been developed since firms wanted to solve a specific problem, and find solutions with a different perspective. These solutions need to seize all the incomes of the processes and generate outcomes with aggregated values. These ideas have evolved and lately production innovation is also considering new trends, which at the same time are aware of different policies in which sustainability is included. Without a doubt there are numerous current trends influencing societies nowadays. However, a set of trends that encompass quite well different social phenomena seeing greatly in the last years are the next three trends: **globalization**, **digitalization**, and **urbanization** (Nordström and Schlingmann, 2014)

Technological progress is determined to be an innovative activity responding to economic incentives. The adoption and implementation of digitalization processes have changed the way production is made (Vallistu, 2013). The transmission of technological knowledge stimulates growth and productivity emphasizing its importance in the production. **Globalization** generates new technologies, firms, markets and principals for competitiveness and subsistence. It speeds industry activities. In addition, globalization enables SMEs to introduce domestic and global markets (O'Reagan et al., 2006). It brings opportunities and pressures for domestic firms in emerging markets to innovate.

Technology has also created a new path where new opportunities are present. New technologies such as digitalization play a fundamental part in making globalization possible, all devices such as smartphones, satellites and computers help to make an effective and fast transfer of information, letting speed and intensity that characterize the modern world to give a rise to a rate of diffusion and transfer of knowledge (Archibigui and Iammarino, 1999). Another important change that can affect innovation is the concept of urbanization. Over the last 20 years, urban areas have changed and growth

which has been a consequence of a combination between technological and political change (Cohen, 2006). Megacities are a consequence of urbanization processes associated with accelerating globalization. Currently megacities are considered as "laboratories of the future" because it reflects global development trends and where several issues can appear but at the same time where they can be solved, and the opportunity for a global transformation exist. Due to their wide range of available human resources and globally linked actors, megacities are considered to have a great potential and sustainability seems like a promising driver of the innovation that happens within these places (Kraas, 2007). A major issue for governments is making urbanization work well while quickly learning how to do it because major challenges in big cities related to poverty, health, and environment could also be directly solved by using sustainability and innovation approaches (Spence et al., 2008). Finally, since innovation can be clustered by many different concepts, the paper framework in figure 1 only includes some of the most known concepts listed next:

- Change-oriented innovations
  - Incremental: These "are minor improvements or simple adjustments in current technology" (Deward and Dutton, 1986; p. 1423).
  - Radical: These "are fundamental changes that represent a revolutionary change in technology. They represent clear departures from existing practice" (Deward and Dutton, 1986; p. 1422).
  - Disruptive: This type of innovation describes a process by which a product or service takes root initially in simple applications at the bottom of a market and then relentlessly moves upmarket eventually displacing established competitors (Christensen, 1997).
- Demand-oriented innovations
  - Market pull: It is defined as "a currently inadequate satisfaction of customer needs, which results in new demands for problem-solving" (Brem and Voigt, 2009; p. 55).
  - Technology push: It is defined as "the stimulus for new products and processes comes from (internal or external) research; to make commercial use of new know-how. The impulse is caused by the application push of a technical capability. Therefore, it does not matter if a certain demand already exists or not" (Brem and Voigt, 2009; p. 55).
- Implementation-oriented innovations
  - Product: "A good or service that is new or significantly improved. This includes significant improvements in technical specifications, components, and materials, software in the product, user friendliness or other functional characteristics" (OECD, 2005; p. 48)
  - Process: "A new or significantly improved production or delivery method. This includes significant changes in techniques, equipment and/or software" (OECD, 2005; p. 50)
  - Marketing: "A new marketing method involving significant changes in product design or packaging, product placement, product promotion or pricing" (OECD, 2005; p. 50)
  - Organisational: "A new organizational method in business practices, workplace organization or external relations" (OECD, 2005; p. 52)

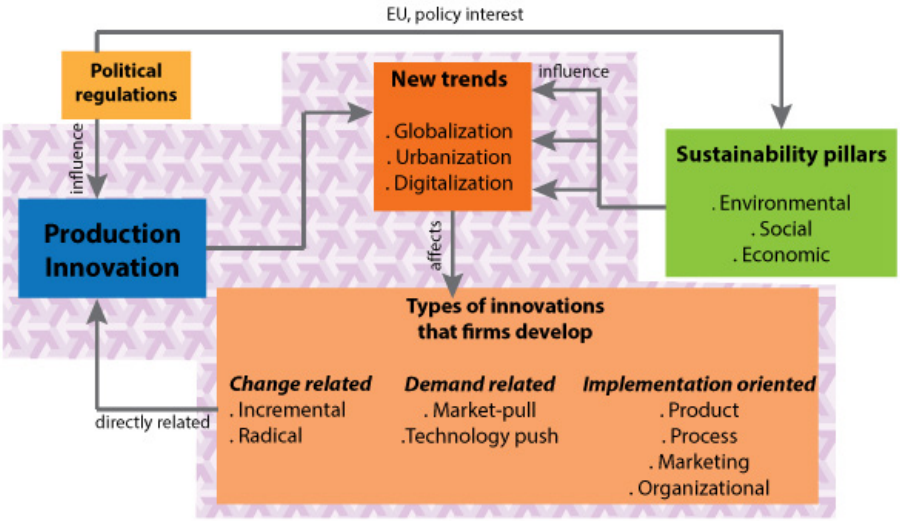

Figure 1. Theoretical framework of this research

3 METHOD

3.1 Research design

Case studies selected method was through an empirical purposive sampling guided by the uniqueness and revelatory nature of the information in the firms, but also because of the opportunity, to study to some extent archetypal manufacturing and manufacturing services SMEs in Sweden. The unit of analysis consisted of studying companies that offer more than a product but a range of services. Likewise, these firms needed to show awareness towards trends such as globalization, urbanization, digitalization or similar concepts that in turn influence its innovation decisions. Therefore, the two case studies, Lindbäcks Bygg and Automation Småland are good examples of SMEs that are dedicated to offer products and services within a frame of innovation driven not only by regulations but also by other trends in the market and in the society in general.

3.2 Case study criteria

The research approach initiated from the case study in a construction company called *Lindbäcks Bygg*, a SME consider as a successful case because of its constant years of growth but mainly because for its innovative products and services. Another logic to choose this company was the clear influence of social global trends in the company strategy. For instance, in one of the first meetings with one of the managers of the firm, she stressed the current emphasis to global trends in different areas. In addition, since we wanted to have a different perspective from other types of firms and regions in Sweden, another case study of an association of firms was used to have a comparison point. Therefore, the researchers coordinated and participated in an event with *Automation Småland* during the first week of December 2014. Automation Småland is a government-funded project that involves companies based in the south of Sweden, which its main objective is to create links between SMEs, suppliers, clients, and big companies to offer state-of-the-art manufacturing services using automation.

The collection of data was done through several steps and different sources of information to allow triangulation of the data (Yin, 1988). These sources included direct on-site observation, websites of the firms and the association, internal documents, participation in lectures with innovation managers, and informal chats with the founders and directors of the firms. In general a mixed research approach during the case study was developed where the authors had the opportunity to have first-hand information. During the study, the research team followed the suggestions to conduct a rigorous case study (Gibbert et al., 2008) while including the case study criteria (Yin, 1988) such as using multiple sources and logic models during the data analysis to obtain construct validity.

3.3 Case study proceedings

To provide external validity and reliability to the case studies (Yin, 1988) we used a replication logic with a second case using multiple units of analysis. In addition, we used internal records for each case study as well as a case study protocol including the analysis that can be summarized as follows:

1. The analysis of the case of Lindbäcks Bygg was by triangulating information such as:
   - Multiple informal talks with the main actors of the company involved i.e. Lindbäcks Bygg.
   - Analysis of different data obtained during the lectures when the workshops were conducted.
   - Analysis of the reports and data that Lindbäcks Bygg provided in its website.
2. The analysis of the second case, mainly in the event of Automation Småland, included:
   - Multiple informal talks with different CEO's and managers of SMEs participating in the event that belong to Automation Småland during the organized conference.
   - Analysis of the product, services and innovations presented by the firms during the seminar.
   - Analysis of internal reports and information available in the websites of the firms, the specialized event, or provided by the committee in charge of the event.
3. The creation of a matrix to depict the overall views of the firms perceived in regards to the influence of new trends on the innovation that they could produce in its production processes.

The unit of analysis was the firm. Therefore manufacturing companies that offer more than just a product but a range of services were chosen. Equally, these firms needed to work or be aware with trends such as globalization, urbanization, and digitalization together with some policies related to sustainability. In this sense, Lindbäcks Bygg and the association of companies Automation Småland are good exemplifications of manufacturing SMEs that are dedicated to offer their products and services under an innovation approach and with the aim of implementing sustainability initiatives.

4 CASE DESCRIPTIONS AND DISCUSSION

4.1 Lindbäcks Bygg and Automation Småland

Lindbäcks Bygg is a leader company for industrial construction in buildings and apartments. It is based in Piteå since 1924. Lindbäcks Bygg is a company in Sweden that builds industrially modular apartments since 1994. Their production is centred in students' residences, renting apartments, affordable condos, and senior houses. The core of the business is the design of modular housings that provide good quality products in a fast and efficient way. The number and sizes of the apartments can vary almost endlessly; which provides diversity in the product offer and customer satisfaction. In this company, sustainability is consider in the process. For instance, the materials they use, reflects years of research and high quality standards. Similarly, the bathrooms floors are outsourced to a firm named 'Blåtraden' which builds the floors with composites ensuring durability that benefits the environment in a long term, safety for the costumer, and production speed. The company has implemented innovations in different areas, from the products, services and organizational practices up to the production and delivery processes. They use a robust communications system that allows them to have a full control of their activities. This system includes a 'checklist system' that provides the capacity to work in different activities at the same time.

Likewise, its specialized service system creates a competitive value in different touch points by interacting with outsourced services. The company modular system that is a one of its major products is one-of-a-kind design, material and technology use on it. Moreover, the R&D department in Lindbäcks Bygg has created a unique production system. Even though, Lindbäcks Bygg shows a great level of innovation, some improvements could still be made. For instance, the company needs to increase their production system if they want to export. A possible option could be through the increment of working shifts or by using automation in their production. Equally, they need to solve some design problems in order to have higher buildings. In this regard, the Internal R&D department could be helpful or by using other sources like consultancy firms or ideas from firms in other industries or countries (Gassmann et al., 2010). Even though their communication system is very good, reducing the number of meetings is an essential challenge they need to solve. For instance, employees could use a high technology system to be constantly communicated. Finally, both internal and external logistics issues could also be improved by using incremental innovations or through the use of specialized consultancy to understand how to improve the work flow of materials and even the delivery of the final product with new and different methods.

As a complement to the first case study, we explore the influence of trends in innovation activities in other manufacturing services SMEs through the case study of Automation Småland, which is a partnership project among different companies (figure 2) that was founded by the Regional Council of Jönköping and the four municipalities of Gnosjö, Gislaved, Värnamo, and Vaggeryd. The aim of the project is to strengthen the automation industry in Småland, an innovative region in the South of Sweden. Using automation, companies that are part of the association, deliver competitive products to customers in Sweden and Europe, instead of being eliminated by low-cost countries. By developing automation companies, they contribute to developing other industries and thus to the competitiveness of the region, in general. The project has different focus areas: business development, innovation, skills supply, research and local educational needs.

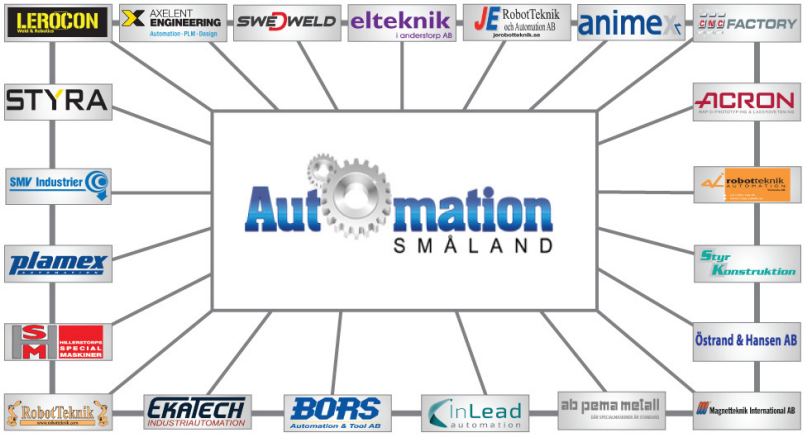

Figure 2. Network of partners in the Automation Småland project.

Småland is known to be one of the most friendly business areas in Sweden and holds several well-known industry clusters. A good example is IKEA, which originated in Småland. The employment rate in the region is been high estimated compared to Sweden as a whole. This, together with high salaries and an expanded public sector has added the basis for the high welfare and good quality of life in the region. The performance of the region compared to the rest of Sweden shows that there still room for improvement (OECD, 2012). All four municipalities are among the six Swedish greatest fluctuations in growth. This depends on the many suppliers in the region and the current regional innovation system in place (Hallencreutz et al., 2011). Companies in Småland can be used as exemplary cases of manufacturing industries that have evolved into services while offering high technology solutions. In addition one of its main strengths that this project has is the idea that all the companies partnering in this project (see figure 2) should gather in a formal event to share their experiences, information, contacts and reinforce collaboration (www.automationsmaland.se).

4.2 Discussion

Both case studies, Automation Småland, and Lindbäcks Bygg are good examples to understand trends in innovation and its evolution. They are working with innovation at different levels and at the same time they are focused on being conform to standards and norms in their industries. In addition, we noticed an interesting but not so obvious characteristic common between all the firms participating in Automation Småland. Although the 21 SMEs see themselves mostly only as providers of automation services, we believe they could fit in a profile of system integrators. In this regards, system integrators are firms that help integrate component innovations into already existing product systems and that also support the entire design of new product architectures (Jaspers and van den Ende, 2010). One reason to suggest this is that, just as system integrators do, the 21 firms seem to have in common the capability to rapidly absorb the diverse technological developments around them from different actors (ibid). In turn, this ability helps them to propose an innovation proposition to its clients and suppliers with a more integrated design of products and services. This is the case with most of the firms partnering in Automation Småland, which closely relates to the idea of the product-service systems (PSS). For instance, these firms seem to understand that their products and services are only efficient and competitive if developed for specific needs of each customer such as easy to maintain and use or upgradeable (Isaksson et al., 2009). Finally, it is also important to talk about the innovation network that this association provides to its partners but also to other actors interacting with these firms such as competitors, or universities, which in turn improved the innovation system in the region and in the country (Hallencreutz et al., 2011). A final step in the analysis of Lindbäcks Bygg and Automation Småland case studies was the creation of a matrix, to summarize, the observed perception of the companies towards the influence of the trends of the innovation they produce (see table 1 and table 2)

Table 1. Summary of Lindbäcks Bygg observed perception.
The answers are binomial variables (0 for a negative outlook and 1 for a positive outlook)

Types of innovation		New trends affecting innovation			
		Globalization	Urbanization	Digitalization	Sustainability
Change-related	Incremental	1	1	1	1
	Radical	1	1	0	1
	Disruptive	1	1	0	0
Demand-related	Market-pull	1	1	0	1
	Technology-push	0	1	1	1
Implementation-related	Product	1	1	1	1
	Process	1	1	1	1
	Marketing	0	1	0	1
	Organizational	0	0	0	1

Table 2. Summary of Automation Småland observed perception.
The answers are binomial variables (0 for a negative outlook and 1 for a positive outlook)

Types of innovation		New trends affecting innovation			
		Globalization	Urbanization	Digitalization	Sustainability
Change-related	Incremental	1	0	1	1
	Radical	1	0	1	1
	Disruptive	1	0	1	1
Demand-related	Market-pull	1	0	1	0
	Technology-push	1	0	1	1
Implementation-related	Product	1	0	1	1
	Process	1	0	1	1
	Marketing	1	0	0	1
	Organizational	1	0	1	1

Both cases of these SMEs were analysed through a qualitative assessment of its production innovations considering their manufacturing processes, and the implications for their innovation processes towards the trends of Globalization, Urbanization, Digitalization and Sustainability. Thus, based on the analyses of the awareness and attitude perceived by the researchers, these tables show that Lindbäcks Bygg and Automation Småland, manage innovation while considering the aforementioned trends in the next different ways:

- Firms participating in Automation Småland have a strong leaning towards using technology suitable for adapting to digitalization and automation to produce innovative products and services.
- Both cases show the openness to use any of the three types of change-related innovations since all these manufacturing firms are starting to also offer services. Also, they have found a market to solve problems between big firms by offering specialized knowledge to solve specific needs.
- In these specific cases the trends such as globalization have greatly influenced in the adoption of new practices in order to be competitive with other growing economies like BRIC countries.
- In the case of Lindbäcks Bygg, the Urbanization trend has positively influenced its products and production to fulfil domestic demand and its possible expansion to other countries.
- In the case of Automation Småland, the Globalization trend has influenced the associated firms because a high priority for them is to be as competitive as other companies that provide similar services or products outside of Sweden.
- It seems that a Technology-push approach is key for Automation Småland because most of their products handle advanced technology that provides them with a relevant advantage among different domestic and even international competitors.

- Most of these firms are creating a full Product-Service System, because they are offering products and a specialized service involving different stakeholders and tailor-made solutions, in which these trends are key factors influencing innovative activities developed in these firms.
- Many initiatives in both cases consider activities towards Sustainability, which is part of their agenda for on-going and future actions in different areas such as production and logistics.

5 CONCLUSIONS, LIMITATIONS AND FUTURE RESEARCH

Nowadays, it seems that most organizations are in a constant race to develop, adapt and implement innovations to grow. Paradoxically, this need for constant growth drives firm´s innovation initiatives even though most of them are aware of the challenges of finite resources. This scenario calls for actions to rethink how the development of innovations can achieve more sustainable organizations. This paper focused on describing and understanding how a balance between the current trends related to innovation and sustainability could be combined into the regular practices of manufacturing SMEs.
The implications of this study show that talking about innovation should imply a multidisciplinary task that involves actors such as society and its increasing necessities. The trends presented in this research, globalization, digitalization, and urbanization are consequences of changes in society. These trends will continue increasing during the next years. Thus, future innovation policies supporting SMEs should consider creating solutions that seize all resources since it is clear that sustainability is a great allay in production innovation. Similarly, production innovation influences processes and products, and thus many manufacturing companies have emerged because of these trends and phenomena. The applications of technology in manufacturing can change the way production is made and at the same time, it can promote new businesses. Thus, we believe that managers in SMEs should seriously consider the three discussed trends, to adapt or create products and services. Finally, the challenge remains on creating an environment that helps foster this kind of practices in the production process and last in the long term while creating synergies with other actors of the society.
Some limitations of this research include that the case studies presented are mainly descriptive and exploratory. However, next steps in this research project are to collect and analyse more data to go more in-depth in the uniqueness that these cases provide. This with the aim to create theoretical constructs, propositions or a mid-range theory from cases (Eisenhardt, 1989) that focus on the idea of production innovation in SMEs rather than innovative products. Moreover, we recognize that the information obtained from the firms in the case of Automation Småland was mainly during the event where they share mainly their self-reported experiences. Therefore, additional data is required to transform the subjectivity of the information provided by managers to be more objective (Eisenhardt and Graebner, 2007). Finally, we only considered three trends, and thus, our framework does not include other possible new trends framing innovation activities in industry and society.
Based on this, we suggest that future research could extend the methodology used and conduct a cross-case study or embedded multiple case studies within one or several SMEs located in the countryside. Likewise, choosing other trends from other disciplines could help to understand the scope of production innovation. As we have discussed the resemblance of some firms with system integrators could explain why they know more than they make. However, future research could focus on the specific mechanisms that these types of SMEs use to expand their knowledge boundary such as Open Innovation (Jaspers and van den Ende, 2010). This could help to understand the factors, trends, drivers and integration mechanisms with other actors (Ramirez-Portilla et al., 2015) that manufacturing SMEs are using to achieve sustainable innovations in their products. A completely sustainable production seems far away, however production innovation seems like a possible solution that will gradually help us to achieve a complete sustainable life.

REFERENCES

Archibigui, D. and Iammarino, S. (1999), "The policy implications of the globalisation of innovation", *Research Policy*.

"Automation Småland". (2014), *About Automation Småland*, available at: http://www.automationsmaland.se.

Barrett, J., Birch, R., Cherrett, N. and Wiedmann, T. (2005), "Exploring the application of the ecological footprint to sustainable consumption policy", *Journal of Environmental Policy and Planning*, Vol. 7 No. 4, pp. 303–316.

Brem, A. and Voigt, K.-I. (2009), "Integration of market pull and technology push in the corporate front end and innovation management—Insights from the German software industry", *Technovation*.

Christensen, C.M. (1997), *The innovator's dilemma: When new technologies cause great firms to fail*, Harvard Business School Press, Boston, MA.
Cohen, B. (2006), "Urbanization in developing countries: Current trends, future projections, and key challenges for sustainability", *Technology in Society*, pp. 63–80.
Deward, R. and Dutton, J. (1986), "The adoption of radical and incremental innovations: An Empirical Analysis", *Management Science*.
Eisenhardt, K.M. (1989), "Building Theories from Case Study Research", *The Academy of Management Review*, Vol. 14 No. 4, pp. 532–550.
Eisenhardt, K.M. and Graebner, M.E. (2007), "Theory building from cases: Opportunities and challenges", *Academy of Management Review*, Vol. 50 No. 1, pp. 25–32.
Firth, L. and Mellor, D. (1999), "The Impact of Regulation on Innovation", *European Journal of Law and Economics*, Vol. 8, pp. 199–205.
Gassmann, O., Zeschky, M., Wolff, T. and Stahl, M. (2010), "Crossing the Industry-Line: Breakthrough Innovation through Cross-Industry Alliances with 'Non-Suppliers'", *Long Range Planning*, Elsevier Ltd, Vol. 43 No. 5-6, pp. 639–654.
Gibbert, M., Ruigrok, W. and Wicki, B. (2008), "What passes as rigorous case study?", *Strategic Management Journal*, Vol. 29, pp. 1465–1474.
Hallencreutz, D., Kempinsky, P., Almerud, M. and Lindquist, P. (2011), *The innovation system in Småland-Blekinge: A comprehensive operations analysis*, p. 54.
Isaksson, O., Larsson, T.C. and Rönnbäck, A.Ö. (2009), "Development of product-service systems: challenges and opportunities for the manufacturing firm", *Journal of Engineering Design*, Vol. 20 No. 4, pp. 329–348.
Jaspers, F. and van den Ende, J. (2010), "Open innovation and systems integration: how and why firms know more than they make", *International Journal of Technology Management*, Vol. 52 No. 3/4, p. 275.
Kraas, F. (2007), "Megacities and global change: key priorities", *The Geographical Journal*, Vol. 173 No. 1, pp. 79–82.
Martin, R., Muûls, M., de Preux, L.B. and Wagner, U.J. (2014), "Industry Compensation under Relocation Risk: A Firm-Level Analysis of the EU Emissions Trading Scheme", *American Economic Review*, Vol. 104 No. 8, pp. 2482–2508.
Merriam-Webster. (2014), "Definition of 'automation'", available at: http://www.merriam-webster.com/dictionary/automation.
Nordström, K.A. and Schlingmann, P. (2014), *Urban express*, Forum bokförlag, Stockholm, p. 250.
O'Reagan, N., Ghobadian, A. and Sims, M. (2006), "Fast tracking innovation in manufacturing SMEs", *Technovation*.
OECD. (2005), *Oslo Manual: Guidelines for collecting and interpreting innovation data*, (Organisation for Economic Co-operation and Development,Ed.), OECD publishing, Paris, 3rd Editio., p. 163.
OECD. (2012), *OECD Territorial Reviews: Småland-Blekinge*, p. 256.
Oliva, R. and Kallenberg, R. (2003), "Managing the transition from products to services", *International Journal of Service Industry Management*, Vol. 14 No. 2, p. 2003.
Ramirez-Portilla, A., Brown, T. and Cagno, E. (2015), "Unravelling the integration mechanisms in open innovation projects: the case of inter-organizational networks", *Journal of Global Strategic Management*, (Forthcoming).
Smith, A., Voß, J.-P. and Grin, J. (2010), "Innovation studies and sustainability transitions: The allure of the multi-level perspective and its challenges", *Research Policy*, Vol. 39 No. 4, pp. 435–448.
Spence, M., Clarke Annez, P. and Buckley, R.M. (2008), *Urbanization and Growth*, Washington, p. 258.
Svensson, G. (2001), "'Glocalization' of business activities: a "glocal strategy", *Management decision*, Vol. 39 No. 1, pp. 6–18.
Ulrich, K.T. and Eppinger, S.D. (2000), *Product design and development*, MacGraw-Hill, New York, p. 330.
Utterback, J.M. (1994), *Mastering the Dynamics of Product Innovation: How Companies Can Seize Opportunities in the Face of Technological Change*, Harvard Business School Press, Boston, MA, Vol. 44, p. 253.
Vallistu, J. (2013), *The Digitized Manufacturing – A Revolution Waiting to Happen*, Oslo, p. 12.
Yin, R.K. (1988), *Case Study Research: Design and Methods*, Sage Publications, Thousand Oaks, CA, 4th Editio., p. 219.

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