Importance and success factors of strategic supplier partnerships in the context of Industry 4.0

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Abstract

The importance of strategic supplier partnerships (SSPs) is widely recognised. Previous research has shown that technological change positively influences SSPs, and that Industry 4.0 entails profound technological change. The researchers aim to examine whether Industry 4.0 influences the importance of SSPs and which aspects are responsible. The authors of this mixed-methods study also attempted to identify additional success factors becoming relevant within the Industry 4.0 context. The results show that SSPs become more important. Moreover, three additional success factors were identified: suppliers' open-mindedness regarding Industry 4.0-specific development programmes, data security, and the partners' ability to develop Industry 4.0-suitable products.

Keywords: Strategic supplier partnerships, Industry 4.0

Purpose

Interfirm cooperation is well known as an appropriate instrument for gaining competitive advantage (Dyer and Singh, 1998). Especially strategic supplier partnerships have received much attention in the literature (e. g. Ellram (1990), Monczka et al. (1998), Nyaga et al. (2010)). According to Hendrick and Ellram (1993, p. 14), SSPs describe "an ongoing relationship between buying and supplying firms involving a commitment over an extended time period, and a mutual sharing of information; it may include the sharing of risks and the rewards of the relationship".

Lee et al. (2009) found that technological change positively influences the prevalence of SSPs. A profound technological change is expected to be necessitated by the fourth industrial revolution (Smit et al., 2016). To the best of the authors' knowledge, no research exists on SSPs in the context of Industry 4.0. To date, several authors only speculated that various aspects of Industry 4.0, such as 3D-printing (Haßmann, 2016), smart objects (Mohr, 2016) and data exchange via Cloud (Weissbarth et al., 2016), could foster the establishment of new or the maintenance of existing SSPs.

Thus, the purpose of this paper is to examine whether the practitioners' expectations regarding the importance of SSPs in the context of Industry 4.0 underpin the findings on the correlation between technological change and the prevalence of SSPs. The authors aim to investigate also which aspects of Industry 4.0 are responsible for the change in the importance of SSPs. Moreover, Bleeke and Ernst (1993) found that almost half of

SSPs fail. Thus, it seems appropriate to explore additional success factors of SSPs that become relevant in the context of the fourth industrial revolution.

After this short introduction, the relevant terms (Industry 4.0, Procurement 4.0 and strategic supplier partnerships) are outlined. The focus of the third part is on the research methods. Then, the results of the investigation are presented and subsequently discussed. Finally, the conclusion draws together the main elements of the paper and identifies future research opportunities.

Literature Review

Industry 4.0

The term 'Industry 4.0' coined in 2011 describes the expected trend of profound changes in manufacturing which will occur in the coming decades (Germany's Federal Ministry of Education and Research, 2013; Smit et al., 2016). Industry 4.0 designates a future project of the German government that focuses on the development and expansion of competitive industrial structures (Obermaier, 2016).

There is a degree of uncertainty around the definition of Industry 4.0. Understandably, a generally accepted definition is lacking. Nevertheless, there is broad consensus that the term Industry 4.0 refers to the smart networking of the whole industrial infrastructure encompassing humans, machines, facilities, processes and products (Obermaier, 2016; Plattform Industrie 4.0, 2015; Roth, 2016). Digitalisation, automation, virtualisation and simulation are expected to become key components of the Industry 4.0-concept (Drath, 2014). By means of virtual models of smart factories, it will become possible to create a copy of the physical world, and self-organisation mechanisms will enable decentralised decision-making (Smit et al., 2016).

The systems which will be required to do this are called cyber-physical systems (CPS) (Germany's Federal Ministry of Education and Research, 2015; Smit et al., 2016). CPS have sensors that collect data, embedded software that processes said data and actuators that influence real processes (Drath, 2014). Moreover, CPS are able to communicate via a data infrastructure (e.g. the internet) and have human-machine-interfaces (Obermaier, 2016). Consequently, CPS enable connections and communication between humans and smart factories (Germany's Federal Ministry of Education and Research, 2015). Previously isolated elements of the production chain become linked and physical objects are expected to become seamlessly integrated into virtual information networks (Harris, 2013).

Moving further along the manufacturing line, every product can share digital information with machines via RFID (radio-frequency identification) as this information is embedded into it (Harris, 2013). As a result, flows of materials become linked to information flows (Germany's Federal Ministry of Education and Research, 2013). Further, intensive information gathering and increasing computerisation has facilitated data analysis and enabled decision-making in real-time (Smit et al., 2016). Due to their modularity, smart factories are able to react flexibly to changes in the environment by changing particular modules without the need to change the whole production system (Smit et al., 2016).

The changes caused by Industry 4.0 will be of both technological and social in nature, and in the business paradigm (Smit et al., 2016). Also, the profound changes in manufacturing are expected to entail adjustments in procurement (Weissbarth et al., 2016). Since procurement is responsible for a high share of the company's total economic activity (Dimitri et al., 2009), procurement has a significant impact on the organisation's competitive advantage and thus on the companies success (Porter, 1985). Moreover, due to their interface function between internal customers and external suppliers (Ellram and Carr, 1994), purchasing is expected to play a significant role in

the context of Industry 4.0 (Pellengahr et al., 2016). Arguably, this distinguished position justifies the focus of the further research on Industry 4.0 in the purchasing context. Similarly to the term 'Industry 4.0', the term 'Procurement 4.0' was labelled (Weissbarth et al., 2016) and is discussed in more detail in the following section.

Procurement 4.0

After the distinguished position of procurement has already been outlined in the previous subsection, it is essential to clarify how procurement is defined, in order to understand what Procurement 4.0 means. Even though there are scholars who argue that purchasing and procurement are not interchangeable terms (e. g. Jahns, 2005), the authors follow the point of view of Leenders et al. (2002) who assert that both terms are often used synonymously. Weele (2010, p. 8) defines the term by stating that "purchasing is the management of the company's external resources in such a way that the supply of all goods, services, capabilities and knowledge which are necessary for running, maintaining and managing the company's primary and support activities is secured at the most favourable conditions".

Considering now the term 'Procurement 4.0', it needs to be recognised that it describes, first and foremost, a further development of the traditional purchasing or procurement term, whereby the key task (securing the supply) will persist (Weissbarth et al., 2016). According to Weissbarth et al. (2016), Bierer and Müller (2016) and Hülsbömer (2016), Procurement 4.0 describes the future-oriented adjustment of procurement to the impulses triggered by and to the technologies associated with Industry 4.0. Thus, the entire digitalisation and networking of information flows associated with Industry 4.0 will be transferred to purchasing processes and are expected to lead to a fully integrated controlling of the whole supply chain (Bierer and Müller, 2016; Hülsbömer, 2016; Weissbarth et al., 2016).

So far, several studies have been conducted to investigate the current level of Industry 4.0 in procurement and the future expectations (e. g. Bogaschewsky, and Müller, 2016; Pellengahr, et al., 2016; Mattes, 2014; Glas, and Kleemann, 2015). Procurement 4.0 is expected to influence the following areas: employees' expertise requirements and the demand for professional training (Glas and Kleemann, 2015), internal positioning of the procurement department (Gracht et al., 2016), purchasing portfolio (Mattes, 2014), contracting and licensing approaches (Vollrath et al., 2015), IT systems (Bogaschewsky and Müller, 2016), supplier management (Pellengahr et al., 2016), planning and risk management (Connaughton and Sawchuk, 2016). One aspect that is particularly noticeable is the more important role of supplier management (Pellengahr et al., 2016). This is remarkable especially regarding the following three aspects.

Firstly, regarding the technologies (e. g. sensors, control systems) that convert conventional components into smart objects, it is expected that strategic supplier partnerships become more important as a reliable atmosphere fostering the joint development and the long-term exploitation of innovations need to be created, especially in times of a low degree of company-internal value-add and shorter innovation lifecycles (Mohr, 2016). Secondly, the willingness to create joint interfaces with suppliers and the data exchange via Cloud might necessitate a certain amount of trust and consequently requires reliable, partnership-like, close supplier relationships (Weissbarth et al., 2016). Thirdly, the purchasing of digital blueprints in the 3D-printing context is expected to call for strategic supplier partnerships in order to continuously receive innovative updates and product modifications (Haßmann, 2016).

Since supplier management in general, and strategic supplier partnerships (SSPs) in particular, form a key aspect of Procurement 4.0, the focus of this paper is on SSPs that are considered in the next section.

Strategic supplier partnerships

Strategic partnerships-like business relationships in general have been focused more intensively by academic literature since the 1980's (e. g. Powell (1987), Ohmae (1989)). In the purchasing context, strategic supplier partnerships (SSPs) were first examined in the second half of the 1980's (Shapiro, 1985; Spekman, 1988; Landeros and Monczka, 1989). SSPs are the expression of a paradigm shift that happened in the 1980's and 1990's (Goffin et al., 2006). The previously transactional and adversarial relationships have been partly replaced by partnership-like relationships (Stuart, 1993).

Hendrick and Ellram (1993, p. 14) defined SSPs in the purchasing context as follows: "An ongoing relationship between buying and supplying firms involving a commitment over an extended time period, and a mutual sharing of information; it may include the sharing of risks and the rewards of the relationship". Additionally, the definition of Youn et al. (2013) emphasises the fact that SSPs are characterised by success and only exist as long as both partners benefit from the partnership. Also, Lambert et al. (1996, p. 2) underline the aspect that SSPs are tailored relationships why "there is no one ideal or 'benchmark' relationship". Moreover, Mentzer et al. (2000) pointed out that strategic alliances concern interfirm relationships what means that they only exist in the business-to-business segment. Furthermore, the common efforts of the partners relate to at least one key strategic area, such as technology (Yoshino and Rangan, 1995).

SSPs can be beneficial due to cost saving reasons, in order to secure reliable sources and to influence supplier's quality (Hendrick and Ellram, 1993). Spekman and Carraway (2006) found that SSPs are advisable for products that are difficult in obtaining supply and that have a high impact on value or economics. However, apart from several advantages, SSPs can be accompanied by drawbacks such as an increase in complexity, a setback of autonomy or information asymmetry (Mohr and Spekman (1994) following Provan (1984)). Moreover, Ellram and Cooper (1990) list risks such as switching costs, lack of control and an increasing limitation of options.

Lee et al. (2009) examined how external factors affect SSPs by analysing whether the two major dimensions of environmental uncertainty (technology change and market uncertainty) influence the probability that strategic alliances are adopted. They find that technological change positively influences strategic purchasing, specific investments and finally strategic alliances (Lee et al., 2009). In contrast, market uncertainty prevents specific investments and thus SSPs (Lee et al., 2009). The positive correlation between technology change, that Industry 4.0 entails, and the adoption of SSPs can serve as further argument for the investigation of the importance of SSPs in the context of Industry 4.0.

Even though SSPs can be advantageous, Tevelson et al. (2013) highlight that a third of the executives involved in close collaboration programs are not satisfied with the achievements of the partnership. Moreover, it should be considered that researchers find that almost half of the strategic alliances fail (Bleeke and Ernst, 1993). So far, Hendrick, and Ellram (1993), Mohr and Spekman (1994), Nyaga et al. (2010), Monczka et al. (1998) and Carey et al. (2011) examined the success factors of SSPs. However, to the best of the authors' knowledge, the success factors have not been investigated in the context of the fourth industrial revolution so far. Therefore, the identification of success factors, that might become relevant in the context of Industry 4.0, is another aim of this study.

Research methods

The literature review has shown that there are only a few titles regarding SSPs in the context of Industry 4.0. Therefore, we conducted an empirical study in order to gain first insights into the topic and to lay the foundation for further research. The research

question, that guides the methodological choice, is whether or not Industry 4.0 leads to a growing importance of SSPs and which success factors become additionally relevant in the context of the fourth industrial revolution.

Regarding the research philosophy, the researchers adopted an ontological stance of social constructionism and the epistemological perspective of pragmatism. According to the aim of this research project, the theory development follows an abductive approach (Saunders et al., 2016). Concerning the research design, the primary data for this study was collected using a mixed-methods approach (Bryman and Bell, 2015). The samples for both the qualitative (purposive sampling) and quantitative part (self-selection sampling) were chosen using forms of non-probability sampling (Saunders et al., 2016).

First, six semi-structured interviews were conducted to collect qualitative data and to explore potential areas of Industry 4.0 that are responsible for the expected increasing importance of SSPs. Moreover, additional success factors were elaborated. Thematic Analysis (Braun and Clarke, 2006) was used to analyse the interviews. In the second step, these results were tested by surveying 38 procurement managers of medium-sized enterprises of various industries in the region of Saxony (Germany). By means of univariate analysis the quantitative data of the self-completion questionnaires was interpreted. The software UNIPARK was applied in order to support the data collection and IBM SPSS Statistics (Version 23) for the data analysis.

Since the sample was collected using non-probability sampling, the findings cannot be applied to individuals other than the participants or better to the whole population. Consequently, the present study results can only be used for descriptive purposes. Thus, they just provide insights into the status quo within the companies surveyed and their future expectations.

Results

The examination consists of three parts. Firstly, the participants of both the interviews and the survey were asked for their evaluations of the current and the future importance of SSPs. Secondly, in order to examine whether Industry 4.0 has an impact on the growing relevance of SSPs, all participants were questioned whether or not the fourth industrial revolution influences their evaluations. Moreover, they were requested to express their level of agreement regarding various statements. Some of the scenarios are results of the literature review. Others emerged throughout the interviews. Subsequently, these statements were tested by means of the survey. Thirdly, the additional success factors, that were mentioned by the interviewees in the context of Industry 4.0, were evaluated by the persons surveyed.

After the results of the qualitative part regarding the future importance of SSPs in the context of Industry 4.0 were somewhat conditional and mixed, the results of the questionnaire are more unambiguous (see *Table 1*). On a scale from one (unimportant) to five (very important), the participants assessed the current importance to be between rather unimportant and undecided (mean = 2,66). However, the future importance was evaluated to be higher (mean = 3,68). The persons surveyed stated that they expect that the future importance of SSPs will be between undecided and rather important.

Table 1: Evaluations of the current and future importance of SSPs

Descriptives		
		Statistic
Please evaluate the current importance of Industry 4.0 for your company/business unit.	Mean	2,66
	Median	3,00
	Variance	1,042
	Std. Deviation	1,021
Please evaluate the future importance of Industry 4.0 for your company/business unit.	Mean	3,68
	Median	4,00
	Variance	1,249
	Std. Deviation	1,118

Regarding the second part, *Table **2*** demonstrates that the persons surveyed evaluated the impact of Industry 4.0 on the growing importance of SSPs to be between medium and high (mean = 3,45) on a scale from one (no impact) to five (very high impact).

Table 2: Assessment of the Industry 4.0's impact on the growing importance of SSPs

Descriptives		
		Statistic
If you quoted an increasing importance, how would you assess the impact of Industry 4.0 on the importance of strategic supplier partnerships?	Mean	3,45
	Median	4,00
	Variance	1,227
	Std. Deviation	1,108

*Table **3*** provides further insights into the question: Which aspects of Industry 4.0 lead to the expected increase in the importance of SSPs? The first three examined scenarios (a-c) are based on the literature (see subsection on Procurement 4.0). The residual statements (d-h) result from the findings of the interviews. Five out of eight statements were validated at least with medium consent (3) on average on a scale from one (strongly disagree) to five (very strong consent).

Table 3: Factors that influence the increasing importance of SSPs

Descriptives		
		Statistic
(a) Presumably, the further flexibilisation of the supply chains could lead to a lower degree of company-internal value-add and could facilitate the exchangeability of both suppliers and buyers. Nevertheless, strategic supplier partnerships are expected to become more important in order to create stable supplier relationships that foster the realisation of joint development projects and the long-term exploitation.	Mean	3,21
	Median	3,00
	Variance	,927
	Std. Deviation	,963
(b) In order to stay up to date regarding digital blueprints in the 3D-printing context, strategic supplier partnerships are expected to become more important as they deliver innovative updates and product modifications.	Mean	2,74
	Median	3,00
	Variance	1,010
	Std. Deviation	1,005
(c) Only strategic partners will be involved in the supplier integration and the data exchange (via Cloud), as a certain amount of trust is required.	Mean	3,34
	Median	3,50
	Variance	1,096
	Std. Deviation	1,047
(d) Smart objects require the purchasing of innovative sensors and control technology. Moreover, particular raw materials are necessary for 3D-printing. Consequently, the purchasing portfolio is expected to change. Strategic partners will be responsible for the innovation scouting.	Mean	2,50
	Median	3,00
	Variance	1,230
	Std. Deviation	1,109
(e) Strategic supplier partnerships are mainly built and maintained with suppliers of A-parts. These relationships are characterised by complex work packages and particular specifications.	Mean	3,71
	Median	4,00
	Variance	,968
	Std. Deviation	,984
(f) Big Data and Analytics are expected to lead to an increasing price transparency concerning C-parts. It is likely that suppliers will be exchanged more often. Nevertheless, strategic supplier partnerships will be important also in the C-parts section in order to serve as back-up suppliers.	Mean	3,08
	Median	3,00
	Variance	1,372
	Std. Deviation	1,171
(g) Process cost efficiency is more important regarding C-parts. Thus, the process cost efficiency that is expected to be entailed by Industry 4.0 will affect mainly C-parts. However, the launched organisational and technological instruments will be also used for strategic partners.	Mean	2,82
	Median	3,00
	Variance	,965
	Std. Deviation	,982
(h) Throughout the entire transformation process towards Procurement 4.0, strategic partners are expected to play a pioneer role. This means that new applications will be tested first with strategic partners.	Mean	3,39
	Median	4,00
	Variance	,948
	Std. Deviation	,974

The highest level of agreement (mean = 3,71) has been given to statement (e) that SSPs are mainly relevant regarding A-parts. This underpins the results of the qualitative part where four out of five interviewees made the same statement in the context of price transparency related to Big Data. Statement (h) reached the second highest level of consent (mean = 3,39). The relatively high agreement with the scenario that strategic partners will play a pioneer role throughout the entire transformation process towards Procurement 4.0 matches the results of the qualitative part where the interviewees have made similar statements in the context of process automation/virtualisation and data

exchange/Cloud. The agreement to statement (c) (data exchange will only be relevant with strategic partners) is 3,34 on average. The participants confirmed statement (a), that the further flexibilisation of supply chains could lead to a lower degree of company-internal value-add and could facilitate the exchangeability of both suppliers and buyers, and that consequently strategic supplier partnerships are expected to become more important in order to create stable supplier relationships that foster the realisation of joint development projects and innovations' long-term exploitation, with 3,21 on average. Last but not least, statement (f) has reached slightly more than medium consent (mean = 3,08). Thus, it could be that SSPs become more relevant if the price transparency associated with Big Data lead to more exchangeability of suppliers and if strategic partners could serve as back-up suppliers consequently.

Finally, the three success factors listed in *Table 4* were examined. These aspects have been identified by the interviewees during the first part of the empirical research. On a scale from one (very low importance) to five (very high importance), the three factors were rated to have at least between a medium and a high importance. Data protection and security was evaluated to be even between high and very high importance. Thus, it is likely that data protection and data security, the suppliers' open-mindedness regarding Industry 4.0-specific development programmes, and the partners' ability to develop innovative and Industry 4.0-suitable products become important aspects that influence the success of SSPs in the context of the fourth industrial revolution.

Table 4: Newly identified success factors of SSPs

Descriptives		
		Statistic
the partners' ability to develop innovative and Industry 4.0-suitable products	Mean	3,61
	Median	4,00
	Variance	,840
	Std. Deviation	,916
data protection and security	Mean	4,21
	Median	4,00
	Variance	,657
	Std. Deviation	,811
suppliers' open-mindedness regarding Industry 4.0-specific development programmes	Mean	3,82
	Median	4,00
	Variance	,911
	Std. Deviation	,955

Discussion

The results regarding the expected increase in the importance of SSPs in the context of Industry 4.0 are in line with the findings of Lee et al. (2009). Lee et al. (2009) found that technological change positively influences the prevalence of SSPs. Moreover, Smit et al. (2016) stated that a profound technological change is expected to be necessitated by Industry 4.0.

In addition to the general statement that SSPs are most likely to become more important in the context of the fourth industrial revolution, some aspects of Industry 4.0 were investigated in order to examine the reasons for the change in the relevance. Two out of three statements that were based on the literature could be validated by the results of the survey. Namely, the data exchange via Cloud (Weissbarth et al., 2016) and the expected increasing flexibilisation caused by Industry 4.0 (Mohr, 2016) probably have an impact on the importance of SSPs. Moreover, three more aspects could be identified by the interviewees and could be validated by means of the survey. The relevance of SSPs for A-parts, the ability of strategic partners to play a pioneer role throughout the transformation process, and the strategic partners' opportunity to serve as back-up suppliers are also important aspects.

Furthermore, the authors found three additional success factors of SSPs that are most likely to become relevant in the context of Industry 4.0. Namely, data protection and data security, the suppliers' open-mindedness regarding Industry 4.0-specific

development programmes, and the partners' ability to develop innovative and Industry 4.0-suitable products were identified.

Conclusion

The findings show that Industry 4.0 as a whole has an impact on the importance of SSPs. These findings are in line with previous research (e g. Lee et al., 2009)). Also, some insights were provided with the question: Which aspects of Industry 4.0 lead to the increase in the importance of SSPs? Moreover, three newly identified success factors are revealed: suppliers' open-mindedness regarding Industry 4.0-specific development programmes, data protection and security, and the partners' ability to develop Industry 4.0-suitable products.

The findings have some implications for practitioners. Procurement managers can prepare themselves for the increasing importance of SSPs by establishing new SSPs or by strengthening existent alliances. Contributing to supplier management theory building, the results provide first indications regarding the questions which aspects of Industry 4.0 are responsible for the change in the importance of SSPs. Moreover, procurement managers seeking to improve the success of their SSPs gain insights into the success factors that are expected to become relevant in the context of Industry 4.0. This enhances their ability to benefit from partnering appropriately and to improve the success prospects of SSPs.

As mentioned above, the findings of this research study cannot be generalised. Thus, future research could test these results with a larger sample. Moreover, only the buyers' perspective has been investigated. It might be interesting to also examine the suppliers' perspective. Finally, the majority of the companies surveyed were from the private sector. An investigation regarding the public sector could also be essential.

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