

Creating and Capturing Value in a Regional Innovation Ecosystem: A Study of How Manufacturing SMEs Develop Collaborative Solutions

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Abstract: In this paper, we investigate how a set of small and medium sized enterprises (SMEs) can engage in business model development within a regional innovation ecosystem. We present a case study based on an action research project on how a set of Danish manufacturing SMEs contributed to the development of their local ecosystem in collaboration with a number of external partners. We specifically examine how these SMEs interact with both competitors and complementors in an innovative automation project. The findings include key drivers and challenges that these companies faced while creating and capturing value both for them and the ecosystem at large. We find that the value creation process is enabled by common goals and financial support, while companies need to balance their core activities with their commitment to the joint initiative. Moreover, ecosystem development is centrally dependent on the value-capture process, which also takes place at the inter-organisational level. Such open innovation process implies a purposive management of knowledge flows at the level of the innovation ecosystem that fits a multi-layered structure of the business model. Through our findings, we link the notions of business model and ecosystems to contribute to the innovation management literature, and to provide practical guidance for future actions within business model and ecosystem development.

Keywords: ecosystem; open innovation; low-tech, manufacturing, small- and medium-sized enterprises (SMEs), business model; action research

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1 Introduction

More than a decade after the introduction of open innovation as a new innovation management paradigm (Chesbrough 2003), researchers have uncovered several determinants and mechanisms of open innovation, nevertheless many aspects are not yet completely understood (West & Bogers 2014; Van de Vrande et al. 2010; Huizingh 2011; Dahlander & Gann 2010). One of the areas that has received increased interest in recent years is the role of open innovation in small and medium sized enterprises (SMEs) (Brunswicker & Van de Vrande 2014; Brunswicker & Vanhaverbeke 2015; Van de Vrande et al. 2009). While this emerging research has identified some of the main trends and mechanisms, a more detailed understanding of the exact conditions under which SMEs can successfully implement an open approach to innovation at either firm or ecosystem level is still lacking (West et al. 2014; Chesbrough & Bogers 2014).

A business ecosystem includes different organizational members that closely interact with one another (Adner 2006). Given the importance of a collaborative approach to creating and capturing value through innovation in business ecosystems, understanding the value creation-capture logic is essential for the development of successful innovation ecosystems (Moore 1993; Iansiti & Levien 2004; Adner & Kapoor 2010). While Adner (2006) underlines possibilities of value creation that no single firm would achieve, research in this domain often considers a large firm (in a high-tech industry) as the ecosystem orchestrator (Li 2009; Adner 2006; Rohrbeck et

al. 2009; Adner & Kapoor 2010). This still leaves questions about the suppliers' perspective and low-tech manufacturing SMEs. This implies a view on ecosystem orchestration that is particularly relevant to SMEs playing a central role in connecting the ecosystem members.

The value creation-capture logic in business ecosystems extends the focus on a particular company to wider sets of collaborative agreements in which the companies engage (Holm et al. 2013; Zott et al. 2011). This implies that SMEs need to consider not only how they create and capture value internally, but also how the development of their ecosystem could serve as an important platform of value creation and capture across organizations (Adner & Kapoor 2010; Chesbrough & Bogers 2014; Rong et al. 2013). Besides, SMEs are particularly challenged to consider the multitude of "coopetitors" or partners with whom they collaborate to create value, and with whom they compete to capture part of that value (Afuah 2000; Bengtsson & Kock 2000; Bouncken et al. 2015; Lim et al. 2010). That is why this paper attempts to find conditions under which SMEs could successfully collaborate and thus develop their local ecosystem. In line with recent literature (Zott et al. 2011), the proposed business model can be adopted as a unit of analysis, where we propose to investigate a collaborative project that effectively attempts to develop a local ecosystem to find new ways of creating and capturing value (see Figure 1).

Insert Figure 1 about here

The objective of this study is to present a viable case of SMEs that, while setting appropriate boundary conditions (drivers and challenges), could contribute to the development of a larger business ecosystem. Through a holistic approach, we have attempted to explore how companies' way of doing business could have a positive impact on the ecosystem that they are part of, and to turn the experience from this project into a subset of recommendations. In this paper, we address the research question: How can a set of SMEs contribute to the development of a local ecosystem through creating and capturing value while developing collaborative manufacturing solutions? We present a case study (partly funded by an EU project) of four SMEs providing free automation consultancy to other SMEs from their business ecosystem located in Southern Denmark. Through an action research approach, the researchers not only investigated the setup but also purposefully functioned as network facilitators who enabled critical comparison across different contexts (across industries, between companies and at an interpersonal level), which otherwise would have been difficult for research participants to conduct alone. The study builds on a wider empirical base including interviews, reports, actions and observations from the project. Our intended contributions in this article are: to provide evidence that not only large companies, but also SMEs can have a positive impact on the development and orchestration of a business ecosystem; and to start bridging the gaps between various approaches to investigate practical aspects of business model development and open innovation paradigm application by SMEs in a larger context of an ecosystem. These contributions should support the establishment and facilitation of future projects to positively influence the development and growth of a business ecosystem, as well as research on this topic.

The article is structured as follows: First, we present the key theoretical concepts of collaboration in open innovation and business model development in the context of an ecosystem. Next, we proceed to the method section discussing how the empirical data was collected and analysed. Finally, we present the main findings and open the discussion about research implications for practitioners.

2 Theoretical background

2.1 Collaboration in an open innovation environment

Open innovation concerns the inflows and outflows of knowledge across organisational boundaries, and it is mostly studied from an organisational level with limited attention to the context dependencies (Huizingh 2011; Vanhaverbeke et al. 2002). In particular, the collaborative context of the ecosystem of complementary innovation partners is becoming an increasingly recognised level of analysis where value creation and capture takes place (Adner & Kapoor 2010; Chesbrough & Bogers 2014; Van Der Borgh et al. 2012). Besides, most research within innovation ecosystems and open innovation in general has focused on early adopters of the concept; typically large multinational corporations as IBM, Lucent or Intel (Chesbrough 2003). Therefore, in this case, we focus on open innovation that takes place at the inter-firm level between SMEs, which not only exists, but also coevolves in a particular business ecosystem.

Companies tend to engage in open innovation activities to accelerate internal innovation to stay ahead of competition (Zott et al. 2011; West & Bogers 2014). Opening up the innovation processes for collaboration with external partners is then inevitable for SMEs—arguably even more than for large firms. Previous studies of open innovation in SMEs have identified trends, motives and management challenges (Brunswick & Van de Vrande 2014; Brunswick & Vanhaverbeke 2015), as well as intermediation and its role in facilitating innovation in SMEs (Lee et al. 2010; Spithoven et al. 2011). Moreover, collaboration for innovation, especially in inter-organisational networks and alliances, is an established phenomenon (Powell 2003; Tidd 1995; Vanhaverbeke et al. 2002). However, the development, organisation and sustainability of such inter-organisational relationships have not been widely examined, especially in the case of SMEs.

Existing literature points out that in order to start collaborating, partners must recognise a potential gain (Dodgson 1993). However, individual motives for collaboration vary from avoidance of external threats to attaining legitimacy and sharing the risk (Oliver 1990). These can be seen as achieving collaborative advantage, where individual organizations need to team up in order to achieve goals which are unreachable alone (Huxham 1993). Despite various examples of collaborative new product development (NPD) (Ritala et al. 2013; Salge et al. 2013), questions like: how, when, and who to invite to the innovation process, as well as how to manage such a collaboration, have not yet been answered (Du Chatenier et al. 2009; Wallin & Von Krogh 2010). New opportunities for value creation are more likely to emerge within a network of companies, especially if it provides prospects of both collaboration and competition (Vanhaverbeke & Cloudt 2006; Ritala et al. 2013; Bouncken et al. 2015). In order to increase the likelihood of interaction, there need to be certain interdependencies and stronger ties between participants of a network, which are prerequisites of ‘membership’ in a business ecosystem (Iansiti & Levien 2004).

2.2 *Value creation and capturing in business ecosystems*

The notion of ecosystem was adopted from biology, where ecologically homogenous units constitute a community of living organisms interacting as a system with various components of their environment. Moore (1993) draws a parallel between the biological system and its business counterpart, where companies striving for new innovations interact both with each other and their widely understood business environment. In the simplest form, an ecosystem could be a combination of different cluster or non-cluster members, who closely interact with one another. In other fields as economics or in particular economic geography, scholars would more likely refer to regional innovation system (Braczyk et al. 1998; Morgan 2007). In contrast to business ecosystems, the emphasis would be on external (most likely tacit) knowledge inflows (Asheim & Coenen 2005; Todtling & Trippl 2004), mainly from research institutions (Cooke 1992; Cooke 2007; Asheim & Coenen 2005), which would be shared among different organisations (Antonelli 1988; Cooke 2007).

The process of value creation in an ecosystem should take place in mutually beneficial collaboration between various partners, leading to a generation of added value to their direct (e.g. customers) and indirect (e.g. society) stakeholders. Value capture can take place at two levels: at company level and inter-company level. It should generate knowledge sharing, expansion of networking contacts, new customers, new products, as well as financial benefits. In this study, we do not elaborate on an ‘internal’ business model of a focal firm, but instead focus on an open system business model (cf. Berglund & Sandström 2013) which evolves at ecosystem level.

Stakeholders of a business ecosystem play different roles in the process of creating value (Adner & Kapoor 2010; Eisenhardt & Galunic 2000; Moore 1993; Van Der Borgh et al. 2012; West & Bogers 2014). However, literature is still lacking a complete understanding of processes that stimulate not only value creation, but also value capture in the context of business ecosystems. Table 1 and Figure 2 provide an overview of some key concepts that are part of the value creation-capture framework in the context of an innovation ecosystem.

Insert Table 1 about here

Insert Figure 2 about here

3 **Research design**

We conducted a case study based on an automation project partly funded by the EU, which can be seen as ‘an extreme or unique case’ (Yin 2009, p47). The project set up includes a consortium of four companies (Partners A, B, C and D) as well as a project support team (see Figure 3). The case study method with embedded action research elements (Coughlan & Coughlan 2009) was chosen due to the increasing importance of a field-based, practice-oriented research contribution in theory building (DeHoratius & Rabinovich 2011). This research design enables getting in-depth understanding of actual company practices as well as in designing and developing the most suitable solutions for

the participating SMEs from the regional Danish ecosystem (Romme 2003). ‘Participating SMEs’ are companies outside the consortium, which receive free automation consultancy provided by consortium members. By embedded action research elements we understand a tight link between the researchers and the research participants as well as deliberate involvement in actions of the research participants. The researchers (not limited to the authors) investigated the process of value creation and capturing by the consortium as well as participated in the project as facilitators and discussion partners, following an action research rationale (Olsson et al. 2010). The motivation for implementation of those elements, as well as its positive implications, was to increase understanding of the context of actions, performed activities, and the reasoning behind them (Huxham & Vangen 2013). We are also aware of the risks of potential negative effects of such an involvement, which could include biased data collection and analysis. Nevertheless, the high contextual understanding, as well as gained trust and legitimacy among the research participants helped to collect more reliable data both during interviews and observations.

3.1 Company selection

The research initially included the process of selecting companies that will be invited for further collaboration in the automation project. First, for the initial interviews the researchers invited SMEs willing to take the risk of joining a collaborative innovation project, as expressed both by their openness for external sources of knowledge and their willingness to collaborate both with competitors and complementors. Second, an important criterion was that the competencies of the future consortium could be merged together into a suitable common goal—in this case providing free automation consultancy. Our main goal was to create a situation where all companies would have the potential to achieve collaborative advantages (Huxham 1993). As a result, there were four companies invited for the next phase of the research, namely the automation project. These four SMEs (Partners A, B, C and D) exhibited a complementary set of skills: two companies are providers of mechanical solutions (Partners C and D), and two companies are providers of software and hardware solutions (Partners A and B). We included two representatives of each set of competencies in order to test for competitive behaviours. Last, the researchers had the power balance in mind, which is also why all of them are small SMEs with up to 60 employees, additionally located in a close spatial proximity (Sternberg 1999; Freel 2003).

3.2 Data collection

Data were collected during two stages over a period of one year. In the first stage, the selection process, the authors conducted 23 exploratory, face-to-face semi-structured interviews with CEOs and managing directors of 12 Danish manufacturing companies. Findings from the first stage were used to design the second stage of the research, which is the action research project representing the research unit of this paper.

Figure 3 presents the overall structure of the project. In order to simplify the nomenclature, this field study experiment will be referred to as a project. The core team comprised representatives from the four industrial partners, the local university, the local development council and a vocational training centre. SMEs from outside the

core team (project participants) were also beneficiaries of the project (those that seek improvements in their manufacturing facilities).

Insert Figure 3 about here

After establishing the setup of this study (see Figure 3), for 22 months empirical data were collected during over 50 internal (analysis, strategy and planning, and steering group meetings) and 77 external (consulting a 3rd party) project meetings, 10 open networking meetings, as well as eight individual evaluation interviews conducted with all partner representatives involved in the project (see Table 2). The data consisted of: recorded interviews, e-mails, as well as documentation of both internal and external partner meetings.

Insert Table 2 about here

3.3 *Data analysis*

This paper focuses on the automation project during which the researchers encouraged all research participants to actively contribute in suggesting potential improvements (Coughlan & Coughlan 2009). In order to achieve data triangulation, analyses were based on six months of observations, participant observations (as project support team members), documentation of the entire project core activities, and interviews. The data analysis process was aligned with weekly project checkpoint meetings as well as milestone evaluations every two months. After the first six months of the project collaboration, eight semi-structured interviews were conducted with all industrial project participants actively involved in the project. Those interviews were part of a circular process of matching theory and reality (Van de Ven & Poole 2002) and were analysed through an inductive framework.

4 **Findings**

4.1 *Understanding business model development in the ecosystem*

The project itself was initiated as an activity with a high value creation potential to be realised through a collaborative process. The main motivation for the companies to join the project was to get new customers (Partners A, B), make partnerships, increase brand recognition, and expand their network of contacts (Partners A, B, C, D). These companies' project goals were taken into consideration as key performance indicators for value capturing and were evaluated as an individual firm-level activity during the project (Ritala et al. 2013). The companies quickly managed to leverage some of the new value created, since after only six months of collaboration, Partner C was already in the process of making specific offers to potential customers, while Partners B and D received new orders. After a year, all companies received at least one new customer order, either individually or jointly with another project partner. At the end of the project, all orders accounted to nine (see Table 2). These orders came directly from other SMEs that were benefiting from the

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consortium's consultancy. Additionally, the consortium members acquired a lot of knowledge about the existing needs of their potential customers, which was an inspiration for new product development (see Table 3).

Insert Table 3 about here

After the first six months, the collaboration between the consortium members got much closer than before the project. All of them claimed that they knew about each other before entering into collaboration. However, closer collaboration helped them in involving each other in additional projects and orders. The biggest challenges encountered in this collaboration are surprisingly not related to the consortium itself and that we put together competitors. Most of the potential improvements centre on collaboration with SMEs outside the consortium. The biggest external challenges (see Table 4) are to connect to potential customers as well as to:

"(...) convince the end user to the new product, new way of thinking. They are not always prepared to it. We are coming with simple things for us, but for them it is breaking news."

Partner B

Insert Table 4 about here

As for the challenges taken place at the company level partners point out the second focus point is internal issues like the amount of time partners need to dedicate to the project as well as how to balance time and resources (Table 4: Partner C, D & O2):

"(...) it was hard for us to find the time. If I had known (...), suddenly it was going very fast and I was not really prepared for that (...)"

Partner C

During the 'preselection' stage of the research, the sample of interviewed companies stated that due to a relatively high risk and scarce resources, it would be difficult for SMEs to get committed to a project or an initiative that would require purely internal funding. Additionally, high uncertainty was not the biggest stimulus to join the consortium. This is why the project acquired external (public) funding for SMEs in order to start up this project. Presence of economic issues/questions was also experienced by other scholars investigating potential barriers to cooperation for innovation in general (Hagedoorn 1993; Blumentritt & Danis 2006) and in particular in SMEs (Verbano et al. 2013; Gassmann & Keupp 2007). Therefore, one of the ways to overcome this problem was to get access to sources of public funding, which along with risk reduction is considered an important motivation to open innovation (Gassmann & Enkel 2004; Schilling 2005; Verbano et al. 2013).

If another collaborative project should take place, without additional financial support, the biggest and the smallest company would drop out of the consortium. Either they would not need any special collaborative project to initiate new interesting activities:

"It is important to have some expenses covered, without money we would just do it alone [without the project]"

Partner D

or they would not be able to join the project at all due to lack of funding:

"(...) is very important. We would not join the project without external funding"

Partner C

All four companies evaluated their partners and their collaboration in a very positive way. The only improvement that was suggested was to expand the consortium by inviting some new ‘unknown’ partners (Partner A). It is an interesting suggestion for future projects. However, it should be considered if any perception and performance difference could occur in the consortium if an ‘unknown’ company would join, as well as *when* it should happen in order to improve the project performance. Still, from an innovation perspective, it would allow for more distant search and possibly more innovative solutions (Rosenkopf & Nerkar 2001).

4.2 *Prerequisites for business model development in the ecosystem*

SMEs would like to be suppliers to big companies, but they prefer to partner companies of a similar size. Therefore, they realise open innovation through strong collaboration with various stakeholders—customers, suppliers, but also competitors (Lee et al. 2010; Kogut et al. 1992). This is probably due to having similar scale challenges as well as potential alignment of their business models. Therefore, the empirical setup was built on the assumption that SMEs solely should be able to form more symmetrical (in terms of power balance) partnerships than an SME and a large company together (Nieto & Santamaria 2010; Blomqvist et al. 2005).

In order to develop the business model in this ecosystem, partnerships should be mutually beneficial. Despite monetary benefits, a big stimulus for collaboration is shared business objectives in terms of target market, or the need to acquire various competencies (Rothwell & Dodgson 1991; Granstrand et al. 1997). Other important prerequisites for conducting successful research on collaboration would be a certain propensity to collaborate as well as a degree of openness represented by the industrial partners invited to join the project.

The analysis of the empirical data gathered in the next research phase provided several relevant findings related to the role of monetary motivation, the direct competitor paradox, and issues of leadership and ownership, at both inter and intracompany level (see Table 4).

4.3 *The role of (monetary) motivation*

Extant research often underlines that financial instability is the reason why SMEs encounter limitations in expanding their scope of activities (Van de Vrande et al. 2009). Nevertheless, our empirical evidence shows that in some companies extrinsic motivation crowds out intrinsic motivation in regard to pecuniary benefits (see Table 4: Partners A, B) (Osterloh & Frey 2000). This might be caused by a relatively low amount of budget offered. The reason why it was so important to include external funding could be found in the pre-study data indicating the importance of financial resources to lower the risk of failure in the proposed collaborative project (Sjödin et al. 2011; Blomqvist et al. 2005). That is why project funding assured money for industrial partners. Each of them is refunded up to 70% of the cost of hours that their employees have spent on the project. These hours can be spent on: contacting local manufacturing SMEs, project introduction meetings, providing consultancy on potential improvements in the manufacturing areas as well as developing solutions,

which could help other manufacturing SMEs in becoming more competitive in the automation field etc.

Our findings show that despite the fact that the availability of money could be a decisive factor in regard to joining a collaborative project (see Table 4: Partner B, C), it does not play a significant role in motivating SMEs to be more active in the project (see Table 4: Partners A, D). Availability of project funding can play an important role for SMEs in lowering the risks of joining a collaboration of uncertain future benefit, as well as in convincing the firm of the significance of such an initiative. This could lead to further divergence in regard to motivation to participate versus motivation to produce. However, what SMEs expect of most of the activities that they commit to are not only short-term benefits (as reimbursement), but mainly long term profits, which could be assured only by acquiring new customers (thus value capturing activities). One of the possible explanations mentioned by one of the partners is the amount of money that the companies are paid for participating, which might be perceived as too small. In general, the development of the appropriate mechanisms—whether monetary or not—remains essential for business model development in an open innovation context (Chesbrough & Bogers 2014).

4.4 *The direct competitors' paradox*

Coopetition, in spite of its potential risks and disadvantages, could also be an effective way of creating innovation (Lim et al. 2010; Ritala & Hurmelinna-Laukkanen 2009; Bouncken et al. 2015). In relationships where competitors compete and cooperate simultaneously, the closeness to the buyer would trigger competitive behaviours (Bengtsson & Kock 2000). However, our empirical findings point out that reducing the distance between one of the partners (from competitive relationship) and the buyer does not increase any competitive behaviour (neither positive nor negative) (see Table 4 L3; O1 & O2, Partner C).

The setup with two pairs of competitors does not appear to have triggered any competitive behaviour. Even if one company gets more involved and starts contacting more potential customers within the scope of the project (see Table 4 L3; O2), it does not motivate their competitor to act. The only answer to this is lack of time to spend on non-core business activities:

(...)That time we were very busy. For me it is ok and if [Company B] gets something out of it, it is ok. I did not have the time to do it so no [no additional motivation due to competitors' behaviour] It would be better if xxx had nothing to do, and I could just say go and take that (...)."

Partner A

An explanation of this behaviour may be related to the biggest challenge that the four participating SMEs are experiencing in such a collaborative project, namely to find a balance between involvement in the core and side activities; related to how to create and capture value through core versus peripheral innovation activities (Bogers 2011; Bogers et al. 2012; Holgersson 2013). The economic logic for cooperation suggests that despite extending the firms' networks, as well as a huge potential in finding new customers (which is one of the goals of the project), the awaiting order is not something that can be neglected. Moreover, even in the situation where a direct competitor would be involved, the current customers and their orders would still be a first priority. The perception of the competitors will be influenced by virtue of the consortium partners who knew each other before entering into the project (Gulati 1995). This also highlights that co-creation of innovative solutions in the larger ecosystem may be part of the key challenges, including a variety of stakeholders, in

which co-opetition also becomes important, supported by the appropriate tools and mechanisms (Afuah 2000; Bengtsson & Kock 2000; Rayna & Striukova 2015).

4.5 Leadership and ownership at both inter and intra company level

During the initial selection process, strong leadership, as well as clear goals, were pointed out by future partners as prerequisites for good collaboration in any joint projects. During the next stage, leadership and ownership issues at inter and intra firm levels were addressed by keeping both collaboration levels in balance, why CEOs should delegate non-core activities to other employees.

During the project, CEOs started to step out of the operational level and remain only at the strategic level (the steering committee) (see Table 4: L4; O2). This happened gradually and from the project team's perspective it improved project efficiency very much. CEOs started to delegate their responsibilities because they were very busy, such as the case of Partner A that indicated:

"because of the time, I have other things to do and xxx[the employee] can do the same thing as I can do"

Partner A

Due to this delegation, companies have not only eliminated situations where their leader with his tacit knowledge would be available for both the company and (to some extent) for the collaborative activity; commitment to internal activities has also increased. More generally, the characteristics and practices of the involved managers become an important determinant for a successful collaboration (Da Mota Pedrosa et al. 2013).

While these findings relate to the ways in which the involved companies try to create and capture value, there are also important implications for business models, which by large become a vital source of competitive advantage. In the context of this collaboration, it becomes apparent that the value creation/capture logic is active at least at two levels (Chesbrough & Bogers 2014). Given that business models comprise a set of activities that do not only affect a single company, but may transcend organizational boundaries (Zott et al. 2011); leadership will be required to develop the business model both at the level of the individual company and the level of the ecosystem.

5 Conclusion

Existing studies suggest that companies fail to capture potential benefits from open innovation due to performing more inbound than outbound innovation activities (Van de Vrande et al. 2009; Chesbrough 2003). That is why our research investigates the case where all organizations use and provide sources of knowledge. What is more, this exploratory study has enhanced the understanding of drivers and challenges for establishing successful partnerships. We find that the value creation process, which takes place between consortium members as well as between the consortium and project participants, is strongly influenced by common goals and lower involvement risk by providing external financial support (Xiaobao et al. 2013). The provision of sustainability enables the facilitation of the collaborative activity

while keeping a balance between involvement in the companies' core activities and their commitment to the joint initiative. However, in the end success is mostly determined by the value capture process taking place at the inter-firm level, which is influenced by the presence of profit potential (Vanhaverbeke & Cloudt 2006). As such, the purposive management of knowledge flows in the innovation ecosystem should fit into this multilayer structure of the business model, which describes the value creation-capture logic for all involved partners (Chesbrough & Bogers 2014).

5.1 Practical implications

Our findings add to our understanding of value capture and creation at the level of a regional ecosystem, building on the importance of open innovation with a special focus on SMEs. Besides, the context of openness in manufacturing and process technology emphasises the importance of broadening the typical scope of R&D and product technologies within open innovation research. Moreover, there may be implications for policy makers. Creation and capturing value seems to be very important for externally funded projects, which are not always as successful as expected. Therefore, some of our findings could also serve as guidelines for applicants of such projects in order to increase chances of successfully meeting all the sponsors' expectations.

From a practical point of view, the findings may serve as guidelines for managers of SMEs and ecosystems, who are either involved in different types of collaboration or wish to be. What is more, not only content-wise, but also method-wise, this paper's findings may be very helpful for establishing successful projects on the interface of industry and academia. It could not only help in increasing our understanding of the drivers of inter-SME collaboration, both at a company and ecosystem level, but also prepare scholars for dealing with various challenges in project and process management; especially while adopting an action research design.

More specifically, we propose some attention points for managers interested in further development of their ecosystems.

- 1) Monetary incentives at company and inter-company level may act as a necessary but not sufficient driver for successful SME collaboration. These could play a substantial role in lowering the risk of joint development of the product (Verbano et al. 2013; Gassmann & Keupp 2007), but alone they do not guarantee any special commitment (Osterloh & Frey 2000).
- 2) Common goals or recognition of potential gain could positively influence the value creation process. Creating a potential for value capture reflected in long-term contribution potential (such as enlarging customers' base or new orders) could significantly increase the successful collaboration. This particular part of our research adds to the existing literature on value capturing processes in ecosystems (Ritala et al. 2013) by extending the scope of managerial activities beyond contractual and relational mechanisms (cf. Faems et al. 2008).
- 3) The inter-organisational facilitation of the collaboration process may play an important role in increasing the commitment and motivation of involved companies as well as knowledge exchange processes (Prashantham & McNaughton 2006; Brunswicker & Vanhaverbeke 2015). This may include managing and coordinating formal and legal project requirements, and keeping track of realising main goals of the project (Ritala et al. 2013).
- 4) A joint or open system business model needs to be developed in order to ensure a viable ecosystem that will not only enable value creation but also value capture

across the involved companies (Chesbrough 2007; Holm et al. 2013; Zott et al. 2011). This includes a coordinated set of activities and a good understanding of the (potential) customer needs.

- 5) A focus on the multi-level development of business models in which both the company and ecosystem are simultaneously managed, while acknowledging the interactive and dynamic nature of this process (Rothaermel & Hess 2007; Chesbrough & Bogers 2014).

5.2 *Limitations and further research*

In this paper, we intended to identify drivers and challenges of small manufacturing firms, which implement an open innovation approach to collaboration in order to create and capture value (Chesbrough & Bogers 2014; West & Bogers 2014; Zott et al. 2011). For the reason that the chosen sample of small manufacturing companies comes from the same business ecosystem and work in the field of mechatronics, it would be hard to generalise the case to the overall population of manufacturing SMEs. Therefore, further research could focus on SMEs from different industries as well as consortia from different regions (Chesbrough et al. 2014; Schuster & Brem 2015; Spithoven 2013; Xiaobao et al. 2013). However, the managerial implications drawn from this work may still be relevant for companies representing the lower end of high tech (in terms of R&D spending amount, such as the machinery and equipment sector).

A second limitation relates to the application of action research elements. There is a risk that the researchers' participation in the project changed some of the drivers or challenges that would normally appear, removing our awareness of their influence on the partners as well as the entire project set up. Therefore future research should consider more cases of SMEs' open innovation collaboration with embedded action research elements in order to verify presented findings as well as contribute to further development of the understanding of collaborative innovation processes. Furthermore, future research could investigate the managerial roles and practices, on both ecosystem and company level (Da Mota Pedrosa et al. 2013). This point could be particularly valid with respect to the facilitation process of collaborative initiatives. Further research could investigate the role of a facilitator in such collaboration and to what extent this facilitator should be dependent or independent of the research units. In this case, the evaluation of a university playing this role could also open interesting research avenues.

A third limitation that should be taken into further consideration is related to availability of external funding as well as its sources along with its influence on the collaboration process. This could be particularly interesting in terms of SMEs, but also in terms of other stakeholders; especially in the case when collaborative initiatives should include more partners with more complex connections.

Further studies are also needed to better understand this research field and to try to develop sustainable (open) business models for this kind of relationship (Chesbrough 2007; Holm et al. 2013; Zott et al. 2011). As a step along this way, the research results offer a good basis for establishing a research framework necessary to develop a business model for SME collaboration in an open innovation environment, which furthermore includes

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an explicit consideration of the wider value chain (Chesbrough & Rosenbloom 2002) and could be extended to the wider environmental context (Bogers et al. 2015). Moreover, business model development in the ecosystem may rely on an interaction between the supporting technology as well as the organization of the business model at company and ecosystem level (Bogers et al. 2014; Rayna & Striukova 2015; Rong et al. 2013). Such mutual influence could then also be subject to future research within the business model literature (Baden-Fuller & Haefliger 2013).

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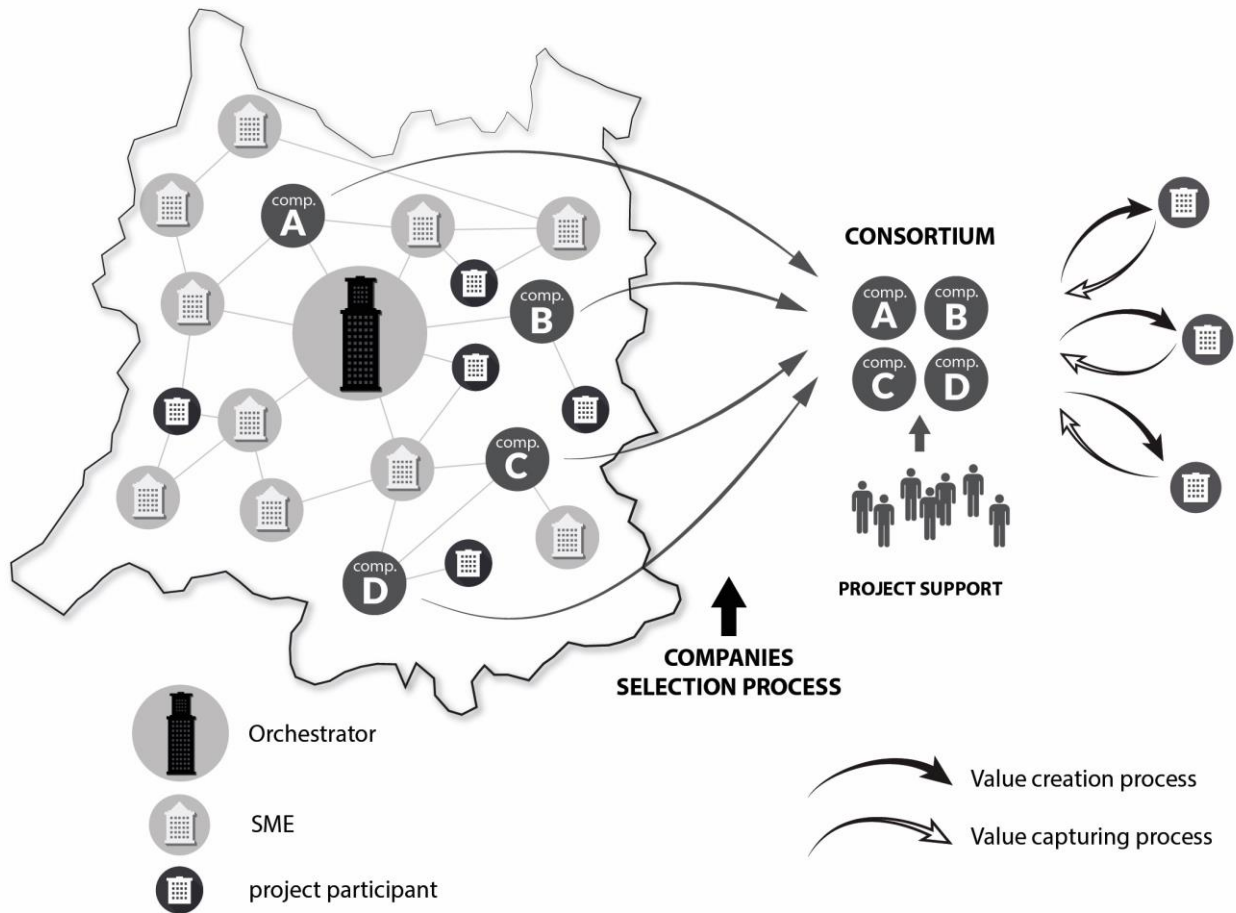
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FIGURE 1
THE ECOSYSTEM & PROJECT SET UP



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FIGURE 2
VALUE CREATION AND CAPTURING PROCESSES IN THE ECOSYSTEM

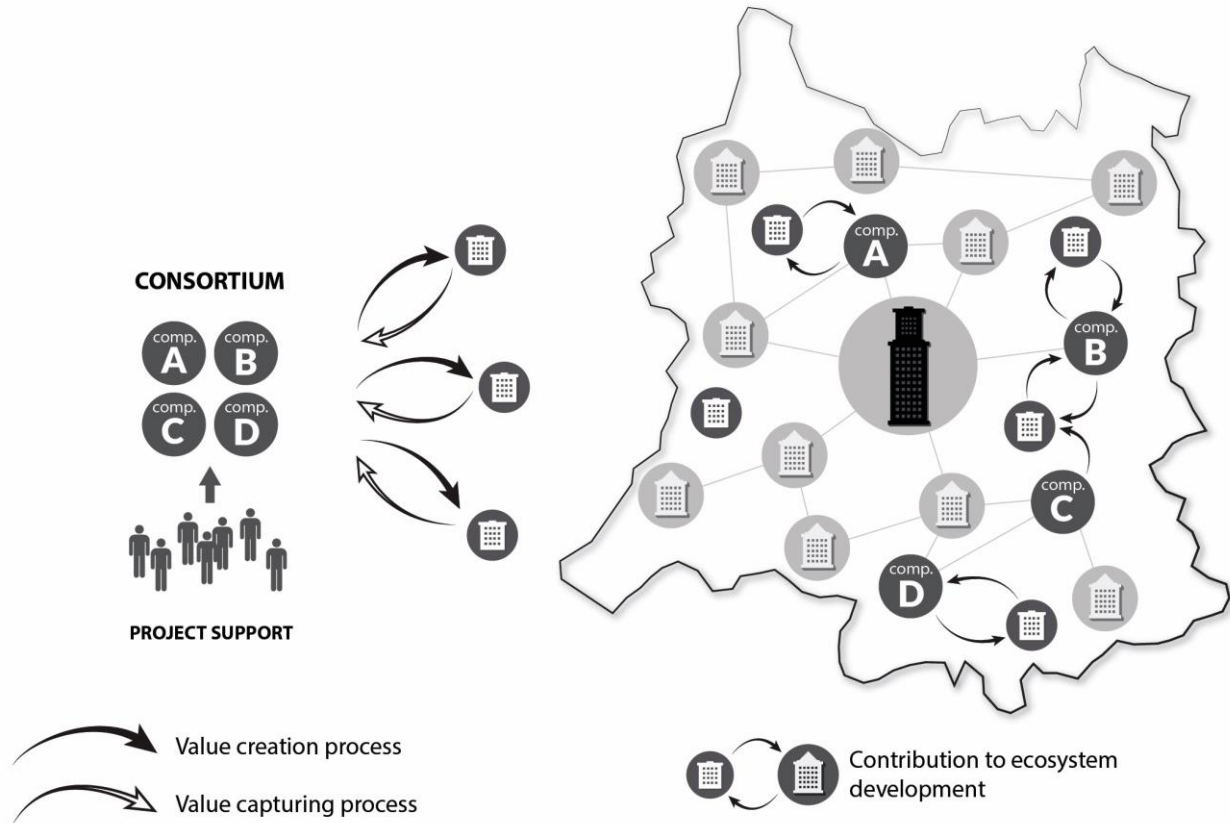
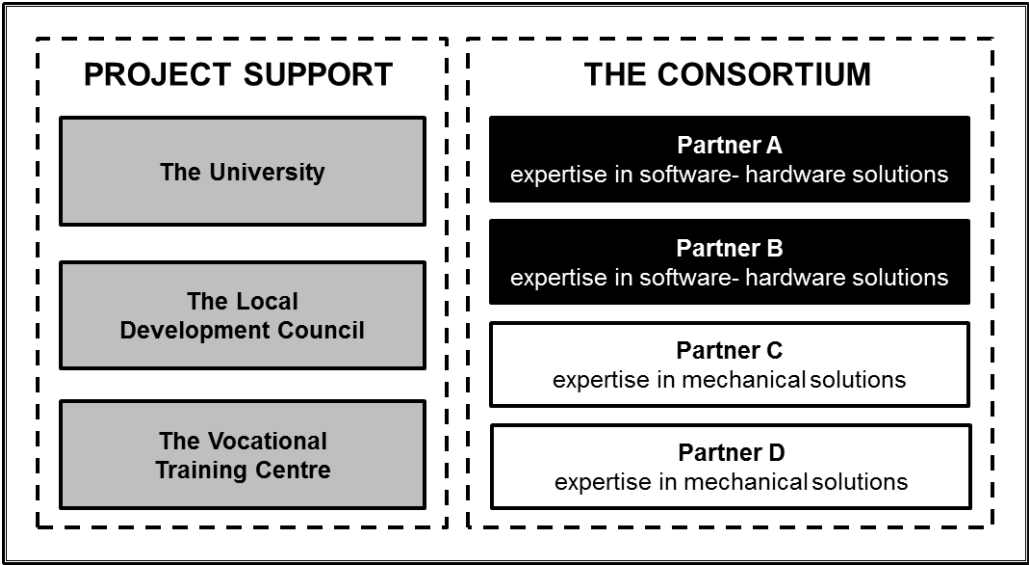


FIGURE 3
THE PROJECT STRUCTURE



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TABLE 1
KEY CONCEPTS IN ECOSYSTEM BUSINESS MODEL DEVELOPMENT

Value creation	This process should take place in mutually beneficial collaboration between various partners and lead to a generation of different forms of added value to their direct (e.g. customers) and indirect stakeholders (society)
Value capture	This process could take place at two levels: a company level and an inter-company level. It should stimulate knowledge sharing, support expansion of network of contacts, new customers' acquisition, new products development and generate financial benefits.
Resources	Need for external resources as well as their availability through collaboration may stimulate innovation processes (Xiaobao et al. 2013) Some examples of considered resources could be time, money, people etc.
Motivation	On the individual level they could vary from avoidance of external threats to attaining legitimacy and sharing the risk (Oliver 1990). Incentives to collaborate may appear thanks to access to new knowledge, skills or widely understood capabilities, which could strongly influence the commitment (Van de Vrande et al. 2009)
Orchestration	Facilitation/ leadership, include processes like knowledge mobility, innovation appropriability and network stability (Dhanaraj & Parkhe 2006) which should also help in increasing innovation output
Goals	Should be connected with recognition of a potential gain (Dodgson 1993). In some studies indicated as focus (Van de Vrande et al. 2009). Should be clear to all partners and aligned both on the company as well as inter-company level.

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TABLE 2
ACTIONABLE DATA COLLECTION AND ITS EFFECTS

	Aug. 2013 - Mar. 2014	Mar. 2014 - Aug. 2014	Aug.2014 - Mar. 2015	Mar. 2015 - Jul. 2015	TOTAL
(value creation) ACTIVITIES					
Introduction meetings about automation & free consultancy opportunities held in project participants (SMEs) and conducted by project support team and consortium members	24	6	8	3	41
Networking seminars / workshops / large firms visits with focus on automation for SMEs	3	3	3	1	10
Analyses of automation opportunities conducted individually in and for a particular project participant	13	1	5	3	22
Development of strategies and plans for automation implementation conducted individually for a particular project participant	4	3	4	3	14
Steering Committee meetings	7	3	2	2	14
(value capturing) EFFECTS					
The number of companies that introduced new machinery and equipment within the project (measured as the accumulated number of SMEs)	2	3	8	9	9

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TABLE 3
NEW PRODUCT DEVELOPMENT INSPIRED BY VALUE CREATION ACTIVITIES

Company A	Since the beginning of the project Company A was focusing on developing four software solutions that allow easier and cheaper data processing. Data processing challenges were indicated as a general SMEs' problem during the 'analysis meetings'.
Company B	Based on the inspiration from projects' participants' visits, Company B started to work on two new automation products. The first one was a new, inexpensive and fully automatic way to collect and present KPI data to decision makers. The product revolves around data logging energy, as this is seen as a major need and an area that SMEs generally do not focus on. The second concept deals with automation and de-palletizing in cold stores, this concept focuses on the improvement of the working environment and ensuring the proper handling of food. The first system has been already tested with one of the SMEs participating during the duration of the project.
Company C	Company C focused on two products: one with incremental changes and one completely new. The first one allowed standardizing modules that can be configured and built together to form new customer solutions. Such transport solutions will make internal logistics cheaper and therefore more accessible to SMEs. The second product/system was focused on the standardization and automation of flexible food machinery for (among other) CNC machines.
Company D	Got a lot of inspiration from the project and wanted to develop a new product called a "Flex Cell". The idea was to create a concept for flexible assembly stations in a size that justified SME investment in smaller series production. Unfortunately, due to lack of (human) resources they have not started to work on this concept yet. Nevertheless, based on the project experience they have developed a tool to quickly calculate the profitability of an automation solution for automation check.

TABLE 4
EMPIRICAL EVIDENCE SUPPORTING THE FINDINGS

	Observations from the early stage of the project (O1)	Observations, from the later stage of the project (O2)	Evidence from Partner A	Evidence from Partner B	Evidence from Partner C	Evidence from Partner D
Challenges of the project (L1)	Contacting SMEs that may be interested in participation in the automation project (which offered them free consulting).	Contacting SMEs that may be interested in participation in the automation project (which offered them free consulting).	“Get in touch with the right people”	“(…) convince the end user to the new product, new way of thinking. They are not always prepared to it. We are coming with simple things for us, but for them it is breaking news.”	“I think it [the project] is going very well. It is just difficult for us because we have been having a lot to do, it was hard for us to find the time, but otherwise I think that it’s been going very well If I had known (…), suddenly it was going very fast and I was not really prepared for that, but I think that if we want to make something out of it, we can do it and we are already making offers for some of the companies” “I was a bit surprised how many hours we needed to put in, in the start and I was not prepared for that”	“(…) find time and resources for the project” “we have some problems with framing concrete solutions with the work we’ve been through” “many things could improve, but it all depends on how many resources we could contribute with”
The role of (monetary) motivation (L2)	Partner C was very concerned about the period duration of payment realisation. In some EU projects involved companies	Partner D was expressing some concerns regarding to the time his company spends in the project. In case if they had	”We get our expenses covered, but the funding is not so high that it could be a big motivation. It is ok.	“The money that we receive from the project takes away the pressure and have money to pay internal people (…) if I take one men out of the	“there were two motivations () one is that we could in cooperation with you guys maybe reach some new customers and one of the other motivation was that we would learn a lot from other companies and the	”It is important to have some expenses covered, without money we would just

	get paid every half a year. In case of his company delay in payment could cause serious difficulties in cash flow.	customers order to work on his employees wage per hour would be much higher than 'delegation' for the project activities.	Normally you get nothing for doing the sales. It is not the biggest issue; it is to get new customers"	[core work] project then he does not earn the money to the company (...) I am not losing so much money. I am losing money, I will, but it is only his cost "	other partners and learn new companies to know and kind of get paid for it, not much money, but we need to do it anyways, that is a motivation for sure"	do it alone [without the project]"
Direct competitors paradox (L3)	Partners A and B as well as C and D did not express any special concerns about the set up and their involvement in the project was more or less on a similar level. Maybe Partner C was slightly less involved, what changed in the later stage of the project when the CEO delegated his responsibilities in the project for one of the employees.	In this stage Partner B turned out to be the most active participant of the project. Therefore we expected some tensions in the relationships between Partners A and B, which did not really appear. Partner A was maybe slightly disappointed that their company could not get more involved in the project, but they claimed that they did not have more time, they could dedicate to these activities.	"Lucky for them, that they had the time to do that. That time we were very busy. For me it is ok and if [Company B] gets something out of it, it is ok. I did not have the time to do it so no [no additional motivation due to competitors' behaviour] It would be better if xxx had nothing to do, and I could just say go and take that. If we do it [engage in the project] is because we want a new	"I have a feeling that we are the only one that give the other companies the opportunity (...) we are the most active also to invite other companies or ask for solutions or prices or give them an access to projects that we are involved into"	"we are having a good cooperation with [Partner B]" "I do not see [presence of Partner D] as an issue" "For me it does not make any difference if [Partner D] is there or not"	"we have no difficulties in handling [competitors present in the project]"

			customer, otherwise, we work for a current customer and that's the way we do it"	Is it motivating for you to have competitor in the project? "No, we can not life from what we do not have (...)"	
Leadership and ownership (L4)	Since the very beginning of the project Partner B delegated participation in the project activities to one of his employees.	As for Partners A, C and D it took a while before CEOs of these companies decided to step down from the operational activities and remain active mostly in the steering group.	"because of the time, I have other things to do and xxx[the employee] can do the same thing as I can do"	"It is the same direction and way we do it today in our company"	"There are goals and leadership and it has really been working good"
