

Relationship development patterns of university-based start-ups

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1. Introduction

Entrepreneurial universities are defined as centres of learning that create and disseminate new knowledge, organize multidisciplinary and boundary spanning activities, and facilitate novel partnership arrangements with support from state and private sector partners (Klofsten et al., 2019). An ecosystem surrounding an entrepreneurial university consists of diverse actors from industries, universities, and society, including both bridging and supporting organizations (see e.g. Clarysse et al. 2014; Isenberg 2010; Oh et al. 2016). Previous research addresses how scientific knowledge is transferred to the market (Boehm and Hogan, 2013; Debackere and Veugelers, 2005; Gilsing et al., 2011). Furthermore, previous research address how start-ups may have a catalysing effect on domestic industries, and may take on active roles in disseminating new technologies (Autio, 1994). Compared to other means of technology transfer such as patenting, licensing, and research joint ventures, however, entrepreneurial activities are less studied (Lockett et al., 2005).

Even though previous studies of entrepreneurial universities all together build a picture of how various actors from industry, university, and other fields shape the start-ups' business, they focus less on start-up performance in the context of the entrepreneurial university after the start-ups have left the university and the incubator (Soetanto and van Geenhuizen, 2019). Moreover, previous studies do not capture how the early relationships formed by start-ups influence the pattern when start-ups develop their business ideas or how their business emerge. It is therefore a need to generate new understanding on how interaction between the start-up and relevant actors in its university and industry context(s) develops.

In the present chapter, we *focus on how start-ups embed in the university and industry context(s)* in order to suggest a research agenda for a more systemic approach to university and industry actors when studying start-up development in entrepreneurial universities. In this chapter, we use an example of transport related start-ups in Western Sweden to explore how start-ups embed in the two contexts and to further the notion of development patterns in relation to embeddedness.

2. Key actors and embeddedness in the university and industry context(s)

2.1 Key actors

Firstly, *universities* have been seen as organizations that gather a critical mass of educated individuals such as students and researchers in one place to generate new ideas. Some of these ideas can then become diffused by start-ups (Westhead and Storey, 1995). *Schools of Entrepreneurship* providing master's programmes of action-based entrepreneurship education (c.f. Fogelberg and Lundqvist, 2013; Rasmussen and Sørheim, 2006) and *incubators* accelerating the development of start-ups (Grimaldi and Grandi, 2005; Mian, 1997) are two types of university-based supporting actors. Incubators may prepare start-ups for the obstacles ahead; they may complement and develop the entrepreneurial ability of the founders, provide advice regarding financing, and give structure and credibility to the firms. Often the incubator

includes elements of co-location of firms, business coaching, and courses (c.f. Aaboen, 2009; Bergek and Norrman, 2008; Hackett and Dilts, 2004; Phan et al., 2005). In addition there are also other *supporting organizations connected to the university* that provides soft funding, business support and legal advice. However, the role of technology transfer offices (TTOs) tends to be less important in Swedish universities due to the teachers exemption. Sweden is one of few countries in Europe that maintains the ‘teacher’s exemption’ model, meaning that the university employed inventor owns the invention to be commercialized (Fogelberg and Lundqvist, 2013; Jacobsson et al. 2013) and can choose to allocate ownership rights (Bourellos et al., 2012).

Secondly, *industry or market-related actors* such as local and global *firms* in the value chain, *industry experts*, and *industry associations* are critical players that can facilitate knowledge development and market formation (Bergek. et al. 2008; Clarysse et al. 2014) and thereby act as relevant actors for the start-up. The early interactions with *potential customers and (other) stakeholders* tend to facilitate knowledge about customer preferences (e.g. Aarikka-Stenroos & Lehtimäki, 2014), as they articulate demand. Furthermore, the critical *first customers* teach the start-up about how to interact with customers (c.f. Aaboen et al., 2011) and can turn into *reference customers* that facilitate further sales and funding, increase the start-up’s credibility in the market, and showcase the initial customers’ commitment to the start-up’s business (see e.g. Ruokolainen & Aarikka-Stenroos, 2016; Partanen et al. 2014).

Other relevant actors groups are funders such as *venture capitalists* (Wright et al., 2006; Shane and Cable, 2002) and *angel funders* (Shane, 2004; Erikson and Sørheim, 2005) who are able to contribute with more financing in later stages of development compared to soft funding. *Governmental actors* and *regulators* who ‘shape’ the markets by deciding on the standards and preferences of the whole society/market are other relevant parties. Governmental actors are particularly important as providers of soft financing in the financing gap between private funding and private equity financing (Mustar et al., 2006).

2.2 Embeddedness

Previous research (e.g. Ciabuschi et al., 2012; Ingemansson and Waluszewski, 2009; Perna et al., 2015) has pointed out that in order for a start-up to develop, it needs to be embedded in specific development, producing and using settings. Perna et al. (2015) argue that the embeddedness is accomplished by interfacing the new solution with other products that are already in use, produced, supplied, marketed, and sold. Moreover, Jack and Anderson (2002: 484), who focus on the social relationships of the entrepreneur, maintain that embeddedness ‘is about joining the structure’. Thus, the embeddedness of start-ups in the university and industry contexts is highly relevant.

The concept of embeddedness was coined by Granovetter (1985: 481) to highlight the importance of considering how ‘economic action is embedded in structures of social relations’. According to Uzzi (1997: 36-37), structural embeddedness can be seen as creating ‘economic opportunities that are difficult to replicate via markets, contracts, or vertical integration’. However, the positive effects of embeddedness are only valid up to a certain threshold and then the embeddedness starts to become a liability since it makes the firm vulnerable to exogenous shocks and unable to access information outside the network. The strength of ‘weak ties’ (Granovetter, 1973: 1360) is an additional key notion pointing to the importance of ties between networks in which relationships are strong(er). Through such weak ties ‘diffusion of influence and information, mobility opportunities and community organisation’ is facilitated (ibid.).

Hence, in addition to strong relationships firms also need access to ‘acquaintencies’, through weak ties, to get access to more ‘distant’ actors.

Studies of start-ups grounded in the industrial network perspective emphasize the emergence of interdependencies with other organizations during firm development, how business relationships that enable start-ups to become embedded in industrial networks are formed, and most importantly, the interaction processes taking place between the start-up and its network of various counterparts (Aaboen et al., 2013; Ciabuschi et al., 2012; La Rocca et al., 2013). Apart from building direct relationships with various actors, the connectedness among relationships is a vital issue for start-ups. The ‘network effects’ emanating from the interconnectedness among relationships (see e.g. Ritter 2000), becomes relevant when investigating start-ups’ relationships. For example, third-party connections are of importance when mediation of contacts and potential development of connections between relationships are concerned (Aarikka-Stenroos, 2011).

A key issue for start-ups thus is how their early relationship formation contributes to embed them in the industry and university contexts. For the entrepreneurial university, a related key issue is how to support relationship formation resulting in embeddedness with a positive effect on the start-ups’ business development. There are latent networks of relationships (based on business exchange as well as social interaction) in the university and industry contexts of the firms, and while these relationships and networks always ‘exist’, they are always specific to the actors involved. Whether or not they can be accessed or utilised by a particular (new) actor depends on the situation and on the initial relationships developed by the start-up within the network.

Our conceptual framework is illustrated in Figure 1. It points to the start-up’s efforts to interact and form relationships with actors in the industry and university contexts. The two contexts (Baraldi & Perna, 2014, Baraldi and Ingemansson Havensvid, 2016, Fini et al. 2011), form the context for business development (Clarysse et al. 2011, Isenberg, 2010). The underlying assumption is that start-ups need to build and develop relationships with industry and university actors to be able to access resources to develop their technology and their offerings.

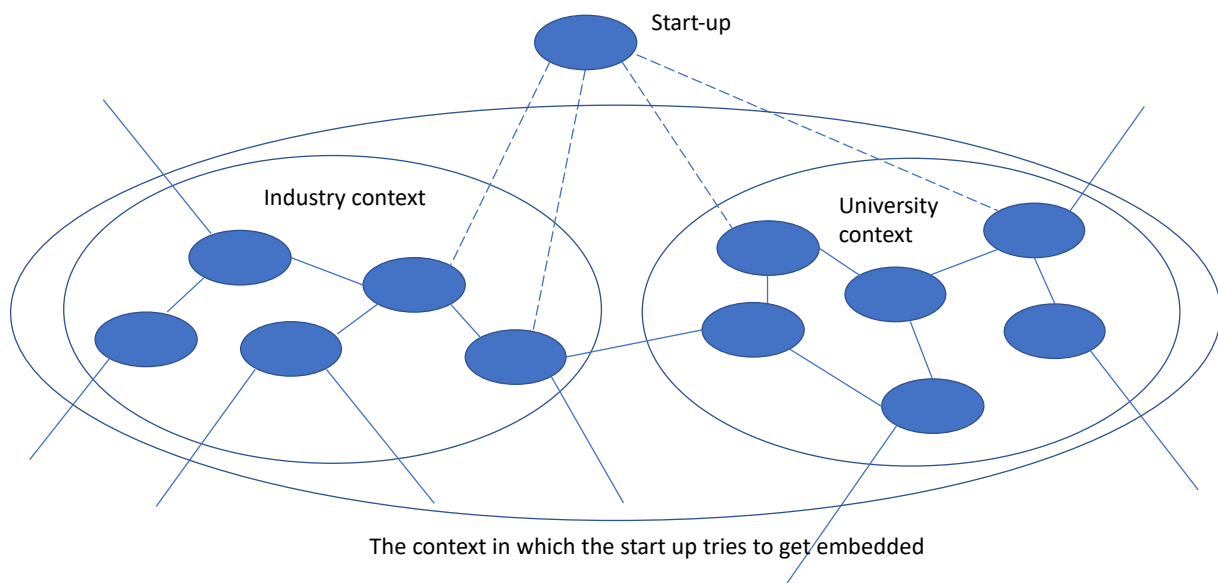


Figure 1 The conceptual framework: A start-up trying to embedded in the industry and university context(s) together forming the context for business development.

In addition, the contexts' features in terms of relationships among the actors in the two contexts is of importance since indirect links to yet other actors are enabled by forming (direct) relationships with 'the right' actors in the two context(s). Hence, vital features of the contexts include the actors and their relationships as well as how the relationships are connected within and across contexts. Hence, the entrepreneurial university needs to consider its ability to support its start-ups' embeddedness processes by developing these contexts.

3. Method

Our case is the automotive and transport cluster in Western Sweden, which is very established as both an academic context and an industry context. In order to capture as much information as possible about how start-ups become embedded in the university and industry context(s) we both needed to collect secondary data about the case as such as well as primary data about the patterns that 'all' start-ups in the cluster have followed.

3.1 Identification of transport-related start-ups

After consulting with the university's investment company and School of Entrepreneurship, 14 transportation-related start-ups were identified and they were all contacted to confirm that they were actually related to *both* transport and to the university. In the selection process, it was discovered that three of the firms no longer existed, two of the firms had changed their names (which means that they were listed twice under different names in the original list), one firm's business did not relate to transport, and one firm wrote an e-mail explaining that it did not want to participate in the study since start-ups need to prioritize their time and resources. Finally, nine start-up firms remained for further analysis (see Table 1).

Firm	Business focus within the transportation industry	Firm-age (years at point of case selection)	Number of employees at point of case selection	Approximate net turnover at point of case selection (SEK).
Start-up1	Booking system, online services, certification and business intelligence of a specific form of transportation.	9	~70	46 000 000
Start-up2	Storing and distribution for internet shopping and marketing material. Both physical and software facilities.	4	4	0
Start-up3	Pro-long the life of forklift batteries.	2	1	490 000
Start-up4	Advanced measurement instrument.	1	2	84 000
Start-up5	Electrical moped.	2	2	0
Start-up6	Light material for the automotive industry.	8	32	25 000 000
Start-up7	Applications consisting of hardware, software and communication for bus operators.	12	18	18 000 000
Start-up8	Optimization software for waste logistics.	1	3	not a public company
Start-up9	Applications consisting of hardware, software and communication for heavy trucks.	10	~50	53 000 000

Table 1: Background information about the start-ups

3.2 Data collection

The main data gathering method was theme interviewing (see Flick 2004). The interviewees were the CEOs, heads of sales, or heads of development, and they were selected by the firms themselves as the persons being most knowledgeable regarding the firm and its relationships. All our interviewees except 1 had been part of the founding team of the start-up and this one interviewee was the first to join the team after the founding team. In some of the start-ups, the CEO was the only employee of the start-up, and in three of the firms, there were two or three employees. In these start-ups, all employees participated in the interviews.

During the interviews, the development of the start-up firms was discussed with a particular focus on 1) the relationships that the firms had build with customers, the university, and other stakeholders such as investors, representing both industry and university relationships, 2) start-ups' business development processes and the role of industry or university relationships in these processes, 3) the start-ups' perceived needs in terms of relationship formation with the goals and business development for the next five years and potential collaborations with the university or other stakeholders. A mind map of the relationships of the firms was drawn by the interviewer in order to keep track of the data and enable follow up. The map was also shown to the interviewee(s) during the interview in order to avoid misunderstandings and to trigger the memory of other relationships. The majority of the interviews lasted between 1 and 2 hours. The interviews were recorded and transcribed. Secondary data was found in various sources, including previous studies of the actors in the university's innovation infrastructure and companies in Western Sweden. In addition, data on the universities' transport researchers' industrial relationships have been used to compare with the stated needs of the start-ups.

3.3 Data analysis

The data from the transcripts and the secondary data was structured both start-up by start-up as well as in tables summarizing a certain part of the data for all cases simultaneously. We first conducted an in-depth exploration of a single case to discern how the start-up processes occurred in each sub-case and what was the role of the different actors from the industry or university along this process. Then we moved towards cross case analysis in which the start-ups were compared with regard to their processes, involved actors and industry and university-based relationships to capture potential patterns across the processes.

4. The case of transport-related start-ups in Western Sweden

4.1 The key industry and university actors in the transport cluster of Western Sweden

Western Sweden has a long history of automotive development and vehicle production (see e.g. Brown, 2000; Engström et al., 2004; Fredriksson and Gadde, 2005) and the largest port in Scandinavia (see e.g. Woxenius and Bergqvist, 2011). There are also *many companies of all sizes that are manufacturing vehicle components or providing services related to transport* (see e.g. Brown, 2000; Johannisson and Lindholm Dahlstrand, 2009). Among these companies, new technologies are continuously being developed in order to improve product quality and safety and to meet new rules on, for instance, emissions. *The large automotive manufacturers and some of their key suppliers* have also been considered an important source of entrepreneurship. The majority of the smaller technology-based firms in the region originate from the local universities and the large companies, and relationships with the previous employer and the university are important (Lindholm Dahlstrand, 1999).

The importance of transport-related companies in the region is reflected in the activities and investments made by *the university*. Since 2010, transport has been one of eight ‘areas of advance’ at the university representing a substantial share of the research and education activities at the university. The research within the Transport area of advance is currently conducted together with researchers at another university in the region by around 200 senior researchers and 350 PhD students (about 15% at the other university) in total. Moreover, the teaching activities in which transport-related researchers are involved cover more than half of the 40 master’s programmes at the university.

A historical account of how the infrastructure for innovation and entrepreneurship at the university has developed can be found in Jacob et al. (2003). It was found that the university’s ‘infrastructure for innovation and entrepreneurship has been an ad hoc experiment with little or no directions and guidelines from the main administration. This has meant that the different components of the structure are “owned” by a few strong individuals and each component has its own legal structure and board of directors’ (ibid.: 1563). Similarly, Rasmussen et al. (2006: 528) state that ‘At first sight, this seems chaotic, but we were told that the initiatives have emerged out of personal initiatives, now constituting a flexible system covering the different phases of the commercialization process’. In 2015, a new organisational set-up was introduced with the intention to boost venture creation by making the system of actors involved more coherent and visible. Among the set of actors involved in the innovation infrastructure the two entities that were most often mentioned by our interviewees were the *School of Entrepreneurship* and the *Incubator*.

The School of Entrepreneurship was founded in 1997 with the purpose of developing high-tech entrepreneurs and high-tech ventures from technology transfer (Fogelberg and Lundqvist, 2013; Rasmussen and Sørheim, 2006). A key feature of the programme is that teams of students are paired with an inventor with an idea instead of coming up with the idea themselves. The projects are financed with up to SEK 100 000, which is raised from local public seed funds (Åstebro et al., 2012). The Incubator was founded in 1999 based on a Euro 5 million donation from a ‘business angel’ (see Fogelberg and Lundqvist, 2013). Rasmussen et al. (2006) found the Incubator to be a coherent entity with a strong vision of what is necessary to meet the specific needs of start-ups. Clarysse and Bruneel (2007) report that the Incubator coordinates its own network of business angels, has relationships with local seed funds and regional development funds for early financing, has a fund that provides a bridge between seed money and professional venture capital and also relies on a network of consultants that provide, for instance, law and accounting services. The coaches spend about one day a week per company (Clarysse and Bruneel, 2007). There are about 20 start-ups at a time in the incubator, and in addition to paying rent, they give up to a 5% equity share to the Incubator (Rasmussen et al., 2006).

At the time of development of the start-ups, there were also other actors in the innovation system of the university, such as a *venture capital* firm founded in 1994 on the university’s initiative and a seed-financing company investing in high potential technology-based firms mainly from the university (Rasmussen et al., 2006), *the university’s institute for commercial R&D*, (Fogelberg and Lundqvist, 2013), the university’s technology licensing, and *the university’s advanced management programs* (Jacob et al., 2003). In addition, the interviewees also mentioned the *university’s science park*. This has been more of an ‘office hotel’ for start-ups and new ventures originating from existing companies that wish to co-locate in close proximity to the research resources at the university. The interviewees also mention ALMI as a source of

soft financing and counselling. ALMI is more of a *policy actor owned by the government and regional development actors*. However, since ALMI often co-invests together with the university's seed fund and creates development programmes for, for example, 'born globals' together with researchers from the university, ALMI is somewhat related to the university's innovation infrastructure. In addition, the interviewees also frequently mention *Venture Cup* (a business plan competition) and the *Connect foundation* as entities that they have been referred to by members of the university's innovation infrastructure. Venture Cup is a national business plan competition existing in several countries. In the competition, the teams present and develop their ideas in several steps. The competition also includes lectures, and so the team members can earn credits through their participation. If the team succeeds in the competition they are awarded a prize, but more importantly, key actors in the national innovation milieu have judged the idea as having potential. The Connect foundation sponsored by regional universities, regional innovation actors, and regional companies is a non-profit organization focusing on the creation of increased employment in many regions and nations around the world. One of the regional companies that sponsor the Connect of Western Sweden is Volvo. Connect mediates contacts within their large network and provides a 'business accelerator' program for small and medium sized firms that wish to grow and works as a 'springboard' for start-ups. During the 'springboard', the entrepreneurial team is able to improve their business plan, get important contacts, and improve their abilities to present their idea. Connect Väst (the branch of Connect that covers Western Sweden) is co-located with the incubator at the university.

4.2 The business development processes of nine transport-related start-ups

In this section, we present and analyze the business development processes of the nine identified transport-related start-ups, with particular focus on their relationships with industry and university based actors. Based on the individual start-up case analyses and cross-case comparisons, we have identified patterns. Noteworthy is that the firms were in different stages with regard to their development. Consequently, some have become more embedded than others in the industrial and/or university context of importance for this study. Next we provide brief descriptions of the nine start-ups displaying their processes from business idea to business development.

Start-up1

The first start-up aims to provide information-system-based services in a two-sided platform that can be scaled up. Currently, it has survived and is growing. In the first phase, i.e. the early development of the business idea, an employee at a large transport-related company generated the original idea and shared the idea with a childhood friend who was a student at the School of Entrepreneurship. A team was formed at the School of Entrepreneurship to initiate a start-up based on the idea that was soon transformed into a rather different idea in the same industry. The School of Entrepreneurship provided the relevant office space, coaching and business education even though the School of Entrepreneurship initially did not believe that it was a good business idea. Other relationships with university-related actors were either weak or non-existent. During the next phase, when realizing the initial business plan, facing markets and establishing relationships with its first customers, two unrelated foreign transport companies became the first customers. Further international relationships were developed without any Swedish market/industry connections. The product was developed in intensive interaction with these customers. The founders approached the first customers without any external support and later managed to use both existing and potential customers as reference customers. A fast growing customer base was important for getting input on the use of the product, since the

product would become more valuable the more user it had. When the start-up reached the third phase, relationships with European transport authorities were developed. Products were developed continuously based on customer needs and entailed expansion of the customer network. The university's students were involved and engaged in master's projects. European transport authorities were important for improving the quality of their services. Interaction with customers was still important for developing new products and services. The start-up displayed organic development except for some acquisitions of firms offering complementary services.

The analysis of the Start-up1 reveals the pattern of Industry- University -Industry. Even though the initial idea was generated by a person employed in the industry, it was developed further as part of the School of Entrepreneurship. However, few other relationships were formed with actors connected with the university. In contrast, relationships with customers are diverse and the interactions influence the development of the firm and product. We therefore view the start-up as being embedded in the industry from the point of reaching the first group of customers.

Start-up2

The second start-up has developed storing and distribution services for internet shopping (both physical and software facilities). In the early phase, a spin-off idea came from a non-transport-related company where the idea was not regarded as a core activity. The idea was given to the SE to be developed into a start-up. The idea generator became the first customer since he had another start-up that was an internet shop in need of distribution services. The start-up was able to gain some diverse additional customers in (generally Swedish) distribution networks. The early establishment of relationships with some small customers have not been enough to enable the firm to reduce its dependence on support from actors at the university for soft financing. To develop its business further, connections have been formed with ALMI for additional funding. The start-up has moved to another part of Sweden and is well connected through social ties in the local community. The start-up is still developing its business idea to some extent by trying out new services and spinning out firms when the scope of services becomes too large.

The analysis of the case shows the pattern of Industry- University- Industry/University. The embeddedness of the business idea in the network of the idea generator seems to have been partly maintained and complemented with the social relationships of the founder and the relationships of the founder with actors connected to business development at the university. However, the start-up's relationships have tended to contribute with additional business ideas rather than ways to reach sufficient business volumes within the areas that the firm is already exploring.

Start-up3

The business by the third start-up is based on prolonging the life of forklift batteries and it is "still trying". The start-up started at the incubator, and is based on the same idea as its sister companies in other countries. The founder comes from a family that is active in this industry in other countries. This provides the founder with social contacts contributing with an expert dimension of both the product and the industry stemming from the sister companies. These contacts were valued higher than the coaching associated with the incubator. The start-up is still in an initial phase, as it has no specific local or regional connections, but some potential customers - logistics companies - in Sweden. It has developed its business idea in interaction with its social contacts in the international sister companies and more local actors in the network of the sister companies and has tried to initiate customer contacts. However, these customer relationships has usually ended after the first trial delivery. The start-up has moved out of the

incubator and has no connections with the university. It uses a modified business model in parallel to keep the start-up in business while still seeking customers for the initial business model.

The analysis shows the pattern: Industry-University-Industry. In this case the sister companies contributed with knowledge of the product and the organization of the company. However, since the product was targeting the Scandinavian market and the sister companies were located in other parts of the world, the sister companies were not able to mediate contacts to the local market. The potential legitimacy from localizing in I was not enough to solve this problem. The firm therefore has been struggling to form relationships in their intended market.

Start-up4

The fourth start-up aims to make business with advanced measurement instruments (hardware and software) and is “still trying”. The idea was generated by a research group at the university. The idea was elaborated along a project at the School of Entrepreneurship. There were several application areas for the product and automotive applications were among them. During the year in the School of Entrepreneurship the firm (4) participated in a competition for start-ups and got a good result. This made it easier for the firm to attract venture capital as well as soft financing from Innovation bridge, VINNOVA and ALMI. About 50% loans and 50% venture capital. However, the firm admits that the financing comes with a price “We approached them with a plan and they expect us to follow that plan in order for them to want to invest more money later”. When realizing the plan the research group and its collaboration partner in another country became the first two customers. The key component is produced by the university’s equipment. The start-up continued networking through the university’s researchers to gain additional customers. It has two small suppliers for the mechanical product and the software. After a few years with office in an office hotel, the firm moved to a university connected science park, thereby increasing its embeddedness among university-related actors further.

The analysis shows a simple pattern: University. Even though the firm has been partly located outside the campus area and has external investors and suppliers the firm has always remained embedded in the university context utilizing the relationships with university actors both for production and as customers. The product is completely developed in the laboratory setting. So far it seems to have been difficult to build enough industrial relationships to materialize the perceived industrial potential and application of the product.

Start-up5

Start-up number five tried to make business with small electrical vehicles but has now given up. The idea was generated by an external innovator over a long time period and later developed as a project at the SE. The next step was product development in collaboration with researchers/teachers and students at the university. Seed funding was achieved from Innovationsbron and VGR. Since the idea had already been developed by the external innovator a long time before the idea was taken on by the start-up, there were already suppliers involved and these were willing to supply parts for the product to the start-up. The suppliers were already knowledgeable of the product and the small electrical vehicle industry. The product had always been something in the area of a delivery trike and the firm used new technology to improve it. There was extensive involvement of the university’s students in the area of product and production management as part of projects and master’s theses. The start-up has been able to draw on the university’s networks of senior managers within the automotive industry to provide

credibility to the project. It initiated contacts with potential customers in need of, for example, short distance transportation and gathered them for focus groups. At the point of the interview the start-up was looking for a production partner. The start-up had a list of 30 different potential production partners but had narrowed down the list to four candidates. "Since we will more or less marry the production partner, due to share certificates for instance, it is important to find a company that feels good". However, currently, there is low activity in the firm and the founder has been recruited to a multinational company developing electrical vehicles.

In this case Industry-University pattern is obvious. The business idea came from the industry and was also accompanied with a network of suppliers. The firm became very much embedded in the university as a student project while being part of the SE with students performing most of the roles within the firm. The firm was not able to become embedded enough in the industry to form customer relationships and develop its business.

Start-up6

The sixth start-up makes business with light material for the automotive industry. It has survived and is growing. The idea was generated by a researcher at the university. The project started at the SE, where the university's investment company invested in the firm. It has developed further for a few years at the incubator and participated in Connect. The first customers came from the automotive industry (foreign). The start-up was participating in trade fairs and the car manufacturer was evaluating the type of material that the firm developed for future generations of cars, and therefore requested a trial order. This caused the start-up to construct an initial pilot production machine. A large investment from a private venture capitalist enabled a move to another location that is still in the region but also close to other actors exploring similar production techniques. Here, offices and larger production equipment with potential for expansion were set up. The first paying customer of firm was BMW. This customer was the reason the firm built the pilot production. In the interaction with this customer the firm realized that they wanted customers with faster product development processes compared to the ordinary automotive industry. The firm therefore started to initiate relationships with customers within the Formula 1 industry. The CEO explains that this is an industry where the actors always try to make improvements "if everything is according to plan and they fix all the details and lower the weight it will be included in the next race." Furthermore the product development process is perceived as faster and less complex compared to the ordinary automotive industry "You have one year, then you have to meet them, because that is when they are testing new materials. You have to know when that is. And if you get it then you have made it, then production starts about six months later." The positive experience of the Formula 1 industry encouraged the firm to also include firms within other sports sectors such as indoor hockey sticks, golf handles and surfing boards in their customer portfolio. The university's investment companies are minority owners. Students from the university and other universities in the region have been involved in projects.

This case displays the pattern of University-Industry. Initially the firm was interacting only within the university sphere. The firm sought new relationships with industry through trade fairs, and so these relationships were not mediated by the university actors. Starting with the first customer relationship, the firm became more and more embedded in industry by letting one customer relationship lead to the next. This way the firm was able to utilize current relationships and relevant knowledge when building new relationships.

Start-up7

Start-up number seven bases its business on applications consisting of hardware, software, and communication for bus operators. In the early business development phase, two inventors who were working at a global ICT company with local presence generated initial ideas for a product. The idea was then developed further in a master's project at the university. The start-up collaborated extensively with university researchers in several research areas. It found investors easily but realized after some time that the margins were too small for the initial product idea and therefore it started to provide consultancy services instead, based on the technology behind the product. When generating business further a 'new' product was developed as part of the consultancy services in interaction with a customer present within the local transport network who also became the first paying customer of the product. The product was based on the same technology as the previous one but was targeted at a different type of vehicle and a different industry segment with better margins. The new product has enabled the firm to expand through sales mostly with Swedish customers. The product is adjusted to each new customer and close customer interaction is therefore required. The firm has also been involved in EU projects and in various societal organisations related to its business and has taken part in Connect. However, the main focus has been on market development.

Analysis shows that this start-up has followed the pattern of Industry-University-Industry. The technological idea was generated by the industry, but the many relationships within the university enabled the founders to re-formulate the technology to become a business idea for a different industry and find several investors. This initial business idea enabled the firm to become embedded enough in the industry to be able to find customers for consultancy services. Then, again, the start-up re-formulated its business idea in interaction with a customer and continues to sell this product to additional customers. The story of this firm emphasizes the importance of customer interaction compared to financial and technical resources.

Start-up8

The eight start-up tried to make business with optimization software for waste logistics but has given up. The early business idea was generated by an employee at a local firm (specialised on transports) based on identified needs. A project was conducted at the SE, and seed funding was gained from Innovationsbron. Potential local customers were involved in the pilot project for testing the hardware of the product, financed by the potential customer. Parts of the product development were carried out by master's students from the university. Other parts of the development were carried out by a specialized supplier accessed through the SE's contacts. Even though the firm was a small customer for this supplier, the supplier was still interested in supporting the firm since the relationship enabled the supplier to learn more about the type of technology that the firm used. The firm had plans for involving master's students. The founding team has now found employment elsewhere even though the start-up officially still exists.

In this case the occurring pattern is Industry-University. The business idea came from the industry. However, the firm soon became very much embedded in the university as a student project while being part of the SE, with students performing most roles within the firm and product development. The firm was not able to become embedded in the industry by forming enough customer relationships.

Start-up9

The start-up number nine makes business with Applications consisting of hardware, software, and communication for heavy trucks/long haul transporters. The business idea was generated

by an inventor employed at a global ICT company with local presence and developed along with a project at the SE. The university's investment company was involved as a part owner. The start-up moved to the incubator and got seed funding from VINNOVA, Teknikbron, and VGR. The first customer was a road carrier that it developed the product in interaction with. During the process the road carrier realized that they could save 10% on the fuel consumption by never driving faster than 83 km/h which would equal 100 000 SEK for each vehicle each year. The customer decided to install the monitoring product in all their vehicles and implement a policy to never drive faster than 83 km/h. The customer then started to boast themselves as "Sweden's most overtaken road carrier" in their marketing. The firm expanded outwards both by finding new customers and by developing additional services for both new and existing customers. The start-up has moved out of the incubator. The firm broke even after six years and started to expand its product portfolio within its identified narrow niche three years later. International expansion followed. Almost all employees recruited during the expansion were from the university of origin; many had started their careers as master's students. The firm has continued to grow this way, and today the firm is present in a handful of countries.

Here the pattern follows the scheme Industry-University-Industry. Bringing the basic technology into the SE contributed to the identification of a business idea suited for different industries. The business idea fit the needs of the industry enough for the first customer to interact with the firm. Together they modify the business idea further. The product enabled then the firm to become embedded within its industry niche.

5. Conclusion and research agenda

The strategic challenges of entrepreneurial universities are divided into internal factors, entrepreneurial pathways, external factors, entrepreneurial teaching and learning, and impact measures. Furthermore, the entrepreneurial pathways challenge may be divided into creating awareness among the researchers, developing enterprise game plans and connecting to supporting actors, providing training, mentoring and coaching, financial support, incubators, and hubs for generating entrepreneurial opportunities through university-industry partnerships (Klofsten et al., 2019). In contrast to this rather linear perspective on entrepreneurial pathways, each individual start-up in this chapter makes a unique and interactive journey in the 'patterned landscape'. Within the incubator literature, the increasingly 'nested' view of incubation (Mian et al., 2016), treats incubation as a more multifaceted, complex and context-dependent phenomenon rather than the activities of a stand-alone organisation (Baraldi and Ingemansson Havenvik, 2016). The nested view of incubators implies that more actors are active in the incubation process than just the incubator itself. Roig-Tierno, Alcázar and Ribeiro-Navarrete (2015) therefore maintain that in order to develop and succeed, start-up firms need to combine help from different network structures. In other words, there are some attempts that are part of the entrepreneurial university literature that attempt to view the paths as less linear and more directed by the start-ups and their embedding in different contexts. The 'patterned landscape' in this chapter concerns both the industry and university based contexts, and from a university point of view there is a challenge to 'design' the context in view of the general needs of support that characterizes the start-ups' development. While the business ideas often come from industry, interactions with industry and university actors complement each other in fulfilling certain functions of importance for the development processes of start-ups, e.g. developing the product and business plan, getting financing, and getting in contact with the first paying customers. By capturing and comparing the start-ups' development processes, we have contributed to the understanding of the process of starting-up as a context dependent but also

idiosyncratic process. However, *identifying and supporting general patterns in the unique journeys of these firms* remains a challenge that should be investigated further.

Given that we have studied all start-ups that are related to both the university and the transport industry, and we know that around 200 senior researchers are engaged in transport research at the university, it is interesting to note that only two of the start-ups originated from research. Most transport-related start-ups in our study are based on a product idea originating from industry rather than from university research, as assumed in the traditional models of knowledge or technology transfer (Debackere and Veugelers, 2005; Gilsing et al., 2011). An interesting finding is that despite this initial anchoring in industry, several of the start-ups have had to start from scratch when trying to identify and develop relationships with industrial customers. The customers that have eventually been identified have often been distant or marginal actors in the industry compared with initial industrial contacts. Furthermore, the university actors are only involved in a very limited way in the start-ups' development, especially when it comes to getting in contact with the first paying customers. We therefore agree with Soetanto and van Geenhuizen (2019) future research on entrepreneurial universities should focus on how to support start-ups post incubation. However, as shown by this study, both the entrepreneurial university and the surrounding industry are active participants in the landscape where the start-ups develop. Hence, *the importance of ties across the two contexts* enabling start-ups to embed in both contexts requires further scrutiny.

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