The impact of business incubators on university spin-offs and their commercialization process: A case study on technology spin-offs and Kennispark Twente

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Abstract
Academic spin-offs are often not able to find the profitable market for their product and thereby fail to commercialize their technology and to achieve a status of self-sustainability. To overcome that problem those spin-offs sometimes make use of business incubator services to fill the gap of lacking resources and knowledge about the market. Three technology spin-offs from the University of Twente were studied based on the impact of business incubator services on their commercialization process and the degree of involvement of the business incubator they were consulting. The findings suggest that medium to high involvement of incubator services usually promise a higher chance of commercialization. Furthermore, some of the involved services can only be leveraged successfully when a sufficient amount of resources from the spin-off itself is dedicated to collaborate with services offered by the incubator.

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1. INTRODUCTION

Business incubators take in a big part when it comes to wealth creation and knowledge exploitation within university spin-offs (Mian, 1996). A business incubator service company supports young spin-off companies with management tasks ranging from giving advice to developing business strategies, attaining funds or general financial resources and educating the emerging company's team to become a management team on their own. The main goal of the business incubation process is to support and educate the spin-off company to eventually become an independent business which can sustain itself in the long-term (Grimaldi & Grandi, 2005). However, as stated by Cohen (2013) spin-offs hiring business incubators usually do not take full advantage of their support but rather focus on exploiting education of professional services in terms of legal advice and financial accounting. On the other hand, some services offered might also disturb the spin-offs potential to become independent from the business incubator at some point. Meaning that the incubator environment does not always offer the same environment as the real world marketplace and spin-offs fail as soon as the incubator terminates its service. Whereas accelerators put a greater focus on education of different entrepreneurial topics and bringing together the spin-off clients with experts from the field by offering educational seminars. Its cooperation time with spin-offs is usually on a short-term basis and does not endanger the potential of independence of the spin-off (Cohen, 2013).

This paper will mainly focus on the impact of business incubators on the commercialization process of university spin-offs and aims to find out which of the services have the greatest impact on the commercialization process. The study will renounce to go in depth into the concept of accelerators since Kennispark being the organization involved in this study can be considered as an incubator based on the time they invest into their spin-off tenants. It will be examined whether a high involvement of business incubators is justifiable for a university spin-off or a low involvement and the spin-off's own resources can generate similar successful outcomes. Several papers investigated the overall impact of incubators on their tenant firms (Mian, 1997; Ratinho, 2011; and Ratinho, Harms & Groen, 2013). Grimaldi & Grandi (2005) studied the perspective of the business incubators and gave a suggestion for positioning strategies based on the type of incubator and the contribution they offer. Binks, Wright, Lockett & Vohora (as cited in Lockett, Siegel, Wright & Ensley, 2005) state that spin-offs are often not ready to pitch to investors and thereby not able to secure funding for their projects themselves. However, detailed studies on the tenant firms - and, in the context of this thesis, the university spin-offs, have not been conducted yet. Taking that into consideration, the research focus will be to study whether business incubators help with improving the commercialization to the extent that strategy and product align to the expectations of the market and enable a (earlier) successful market entrance of the product.

1.1 Problem statement

Universities are nourishing ground soils for innovative ideas generating a decent amount of university spin-offs every year. However, not all of these spin-off companies make it to a successful long-term survival and tend to fail at an early stage of development (Vohora, Wright & Lockett, 2004). According to Willemstein, van der Valk & Meeus (2007) one factor mentioned to have an influence on these failures is the static approach of the business model that is not applicable to university spin-offs. Such spin-offs rather need to acquire an incremental approach of business model design and review it on a regular basis. This is due to different market and technology uncertainties playing a role in the environment the spin-off would like to launch in (Willemstein, van der Valk & Meeus, 2007). Further, critics mention the lack of business management skills of researchers involved in the business development of the spin-off companies (Bower, 2003). Those university spin-offs fail because they are not able to pass the *"threshold of sustainability"* (Vohora, Wright & Lockett, 2004, p.152) by earning own revenue streams and eventually going out of money which would be needed to proceed with further development of the product and the business.

1.2 Research questions

This research aims to investigate the role of business incubator involvement within the technology commercialization process of university spin-off. A special interest lies in the question of whether higher degree involvement leads to higher success rates than lower degree involvement. Furthermore, it will be investigated whether some of the business incubator services have a greater impact than others. The main research question that arises from that research aim is:

Does a high degree of business incubator involvement show a significant advantage in a successful technology commercialization process of a spin-off compared to a low degree involvement of the business incubator?

This question will be supported by the sub-question:

If that is the case, do some business incubator activities show a greater impact on the commercialization process and thereby on the entrepreneurial learning process than others?

To answer the research questions, the current literature on business incubation and university knowledge commercialization has been reviewed. Afterwards, interviews with different university spin-offs have been conducted to find out whether the involvement of business incubators shows a difference in the commercialization success.

2. THEORETICAL FRAMEWORK

The following section reviews the different literature on the underlying topics of organizational and entrepreneurial learning. Further review will be made on business incubators and accelerators and their role in general. Both aspects will be combined to find out what role business incubators play in university spin-offs. Further insight will be given into the resource-based theory and the role of networks in the start-up process. From the literature review ideas for the design of the interview questions and the related variables have been derived.

2.1 Organizational and entrepreneurial learning

Many definitions of entrepreneurial learning draw back on definitions of organizational learning or even in a broader sense on the general term of learning. Starkey (as cited in Harrison & Leitch, 2005) emphasizes that learning is a mean for knowledge generation aiming at the reduction of uncertainty. Another definition suggested by Fiol & Lyles (1985, p.811) describes learning as "The development of insights, knowledge, and associations between past actions, the effectiveness of those actions, and future actions." According to Argote (2013, p.31) researchers generally agree on "organizational learning as a change in the organization's knowledge that occurs as a function of experience" (e.g. as elaborated by Levitt & March, 1988). When looking at studies conducted specifically on the term of entrepreneurial learning, not many differences exist between the term of entrepreneurial and organizational learning. Rae & Carswell (2000) discovered that active learning by the means of direct experiences and experimenting contributed to the entrepreneurial learning process for the most of their samples. However, social learning, which includes the adjustment of own

behavior concluded from observations of peer groups (Bandura, 1977), played a similarly significant role to those samples. For example, powerful personalities such as other entrepreneurs, successful business people or academics functioning as mentors influenced the entrepreneurial learning process as well. This shows that not only own experience can add to the process but also the experience of others can take in a major role in it (Rae & Carswell, 2000). A very specific definition seemingly focused on the entrepreneurial learning processes in startups is given by Politis (2005). Thereby entrepreneurial learning can be seen "(…) as a continuous process that facilitates the development of necessary knowledge for being effective in starting up and managing new ventures" (Politis, 2005, p. 401). In this context, the theory of double-loop learning plays an essential role. It describes that problems should not only be solved by trying a different solving approach, but also by reevaluating current goals and values of the company (Argyris, 1976). Since this study focuses on university spin-offs, it is interesting to see in how far universities can contribute to this learning process and set the grounds for a successful commercialization of a new technology. The following paragraph will give more in-depth insight into this topic.

2.2 Universities as nourishing environments for technology commercialization

Nowadays universities do not only serve as academic knowledge transfer or research centers. Due to the emergence of new research domains in different fields of technology, the role of the traditional teaching university changed into an institution that can contribute to the general economy and society and promote entrepreneurship (Rasmussen, Moen & Gulbrandsen, 2006). In a study conducted by Klofsten & Jones-Evans (2000), two basic activities were found to be important to be present in a university which promotes entrepreneurship. That includes a university culture which encourages entrepreneurship and training and courses compiling topics on entrepreneurship (Klofsten & Jones-Evans, 2000). Several other papers suggest certain competencies a university or university department should have to support the commercialization of research; for example: Rasmussen, Mosey & Wright (2011) investigated that the competencies of (1) opportunity identification and development, i.e. the ability of the entrepreneurial team to exchange with industry partners; (2) championing competency, i.e. attracting external project champions from the industry; and (3) resource acquisition, i.e. gaining trust from actors that act as gatekeepers to get access to resources, are essential to the commercialization a technology. Possessing those three competencies seems to be important for the future credibility of the emerging spin-off and key to access further resources. However, one prerequisite of those competencies is a positive attitude towards entrepreneurship and technology commercialization of the head of the department itself (Rasmussen, Mosey & Wright, 2011). Similar findings were made in an earlier study by Rasmussen & Borch (2010). Competencies found in that study focused on (1) opportunity exploration and by that finding new business ideas within the university; (2) acquisition and allocation of external resources; (3) balancing the interests of the university organization and the interests of the commercial spin-off (Rasmussen & Borch, 2010). (For reasons of clarity and comprehensibility the competencies from Rasmussen, Mosey & Wright (2011) and Rasmussen & Borch (2010) are comprised in Table 1.) Nevertheless, as recognized by Vohora, Wright & Lockett (2004), universities do not always have the necessary resources available, academics are lacking skills in technology commercialization and different stakeholders can aggravate the growth of the spin-off company due to the disunity of interests. Still, some of those lacking resources and skills can be retrieved externally by e.g. consulting business incubator services. The following paragraph focuses on incubators and their contribution to the success of a spin-off.

	Rasmussen, Mosey & Wright (2011)	**Rasmussen & Borch (2010)**
Idea generation		Exploration of new business idea within the university environment
Networking	Ability to exchange with industry partners	
Resource acquisition	Attracting external project champion from industry	
	Resource acquisition	Acquisition and allocation of external resources
Mediation		Balancing university interests with commercialization interests

Table 1: University competencies to push commercialization (summarized from Rasmussen, Mosey & Wright, 2011; Rasmussen & Borch, 2010)

2.3 Business incubators and accelerators and their role in the commercialization process of university spin-offs

In a study conducted by Mian (1996) it has been concluded that "university business incubators are proving to be a viable strategy for providing the necessary resource-base and environment conducive to development of research/technology-based firms" (Mian, 1996, pp. 205-206). As already mentioned in the introduction slight differences exist between business incubators and accelerators. Spin-offs taking part in a business incubator program take between one to five years to commercialize and since incubators do not possess their own investment funds to put into the spin-off company, external funds have to be attracted to invest into the spin-off. Usually, new spin-off projects are selected during the whole year and education is only used to the extent of consultancy in the field of accounting and legal advice (Cohen, 2013; Hackett & Dilts, 2004). On the other hand, accelerator programs usually do not last longer than 3 months, which is mainly due to the reason that they keep interdependency between accelerator and spin-off company to the minimum. Business accelerators are private-owned companies which possess own investment funds to invest into the spin-off companies and take equity stakes in the spin-offs that participate in their programs. The selection phases take place one to two times a year where big amounts of spin-offs are taken into the program. Their education focuses intensively on deepening the knowledge in entrepreneurial topics and providing training on network development during seminar sessions.

According to Grimaldi & Grandi (2005), business accelerators are also known under the term of Independent Business Incubators (IPIs). Other private-owned incubator models are Corporate Business Incubators (CPIs) which are normally set up by bigger companies to support new emerging business units within the own company. Public-owned incubators differ in two kinds: Business Innovation Centers (BICs) which focus on offering tangible resources in the form of office space, while University Business Incubators (UBIs) support spin-offs with

tangible (office space, access to funds and networks) as well as intangible resources (access to university advisers and employees, research services, trainings and technology transfer programs (Grimaldi & Grandi, 2005; Mian, 1996). However, studies from recent years show that business incubators are adapting to each other and offer increasingly similar services the same services (Bruneel, Ratinho, Clarysse & Groen, 2012). According to the findings of Mian (1996), spin-off companies using services of UBIs are proved to have a higher performance in terms of survival and growth. However, the same study also claimed that the responses might be falsified by originating mainly from the successful firms (Mian, 1996). Building on that, a study by Ratinho, Harms & Groen (2013) showed no impact on problem-solving of incubators and the spin-off companies they are supervising. Even worse, business incubators might focus on the wrong types of problem to solve for their spin-off clients (Ratinho, Harms & Groen, 2013). In conclusion the following question arises: If incubators focus on the wrong problems after all, should spin-offs solely rely on their own resources and discard incubator consultation completely or is a mix of both the optimal way to the success of the commercialization? In that context, the next paragraph goes back to the basics and explores the importance of resources and their usage to achieve the ever-desired capability of own sustenance and competitive advantage.

2.4 Resources as a basis of competitive advantage and sustainability for spin-offs

As elaborated in the previous sections, resources play an important role in the formation and technology commercialization. In his article Barney (1991) states that tangible resources (e.g. firm assets, processes, etc.), as well as intangible resources (e.g. capabilities, information, knowledge, etc.), can, in general, contribute to the efficiency and effectiveness of firm processes. When implemented in a value-creating manner those resources can even create a competitive advantage to other firms. In cases where competitors are not able to imitate those resources, the firm might also be able to achieve a sustainability status and set a basis for long-term survival (Barney, 1991). Building on the development process of university spin-offs elaborated by Vohora, Wright & Lockett, (2004), Bigdeli, Li & Shi (2015) state that spin-off sustainability presumes having the organizational flexibility to constantly revise the business model and possessing collaborations with important players from the industry. Based on those capabilities, spin-offs can then continue into the state of scalability, expand their business into several product lines, increase their customer base and enter international markets (Bigdeli, Li & Shi, 2015). Zimmer (1986) emphasizes the importance of networks and social resources. Casual acquaintances, so-called weak ties, are more valuable to an entrepreneur to get diverse information about customers, investors and markets, than strong ties where information tends to overlap. Galbreath (2005) elaborates on important tangible and intangible resources that can lead to firm success and underlines thereby the importance of organizational assets and its' contribution to success.

3. METHODOLOGY

To investigate to what extent business incubators have an impact on the success of commercialization in spin-off companies, semi-structured interviews with the founders of the three university spin-off companies were conducted. Due to the short amount of time that was available for the research study, the number of cases was limited to three items. Biases might have occured in terms of the representativeness of the sample itself and also positional and personal biases by the founders or employees that were interviewed. All three spin-offs were at some point in their formation process involved with a business incubator. Nevertheless, the degree of the business incubator involvement differed in terms of services provided and also time invested. All spin-offs were founded at the University of Twente. The business incubator used by the spin-offs was Kennispark Twente. Kennispark Twente is a well-known incubation-providing business located on the campus of the Twente University. As taken from the online database of Kennispark (2016) and an interview conducted over email with a business developer employed by Kennispark, the business offers among other things coaching and professional help on business plan creation, marketing and strategy, skills-based training programs, and access to networks of regional companies, venture capitalists and informal investors. The business approaches on average ten potential spin-off companies per year to commercialize new findings in current research projects and thereby exploit university knowledge. It further supports the spin-off business with the application for grants given out by public and private foundations such as the governmental STW Valorization Grant Program[1]. Kennispark established its own initiative program to help young spin-off companies to find a place in the market and commercialize their product. Spin-offs participating in the TOP (Temporary Entrepreneurial Position) program profit from different services such as "(…) access to support, advice, networks and financial aid for a full year to facilitate the start of their new business" (Le Loux, 2015; Kennispark, 2016). Finally, to complement the results of the interviews, further content analysis in the form of internet research has been conducted. Therefore, a closer look has been taken on to the websites of the spin-off companies.

A purposive sampling was drawn for the qualitative analysis to be conducted in-depth. This serves the purpose to study the topic on spin-offs and commercialization extensively and potentially to come across new phenomena that have not been considered in the context, yet. To find a representative sample relevant for the study, the following criteria were predetermined, based on the context of the variables in the research questions:

- All three spin-offs should have had a different degree of business incubator involvement
- The spin-off should not have been older than 5 years, thus have just enough experience to formulate a strategy and business model, but avoid to have too much experience in the market where a consultation of a business incubator would not make sense anymore
- All spin-offs should have already established a first entrance in the market and either already distributed their first batch of products to the customer or at least are in negotiation with potential customers about the distribution of their product
- All companies should have been university spin-offs which were founded for the purpose to commercialize academic research knowledge or a new technology invented in a university environment. Those spin-offs can be either founded by university staff or students.

Interview questions were designed in such way that the first two set of questions focused on general information about the company. The following sets were divided into the topics of (1) commercialization and product development and the revision process, (2) industry networks and resources, (3) entrepreneurial training and business development skills, and (4) involvement of business incubators. The full set of questions to the mentioned

[1] Governmental fund given out to innovative spin-offs commercializing academic knowledge

topics can be found in the appendix part. Probing questions were asked to get detailed information about the certain topics or to clarify the response of the interviewees. All questions were formulated based on the concepts discussed in the literature. Interviews took on average 30 to 45 minutes. Full audio recording material can be made available on request. For analyzing the concepts of commercialization success the following units will be observed:

- *First time product sold after the formation* to have an approximate measure of how fast/early the commercialization was reached
- *Products sold* to measure the success of commercialization
- *Number and type of customers* to predict an approximate future success (assuming that distributor stores will set contracts and order in bigger batches compared to private consumers)

For analyzing the concept of the entrepreneurial learning process and which incubator activities have a greater impact compared to others, activities the incubator was involved in, were reviewed. The activities were categorized after the four components introduced by Bergek & Norrman (2008):

- *Shared office space*
- *Shared support services* (including financial advice, legal advice, etc.)
- *Professional business support* (entrepreneurial training, business development coaching, etc.)
- *Network provision*

Based on the number of activities utilized, the spin-off companies will be classified into the following categories:

- *Low incubator involvement* (involved in one activity from one of the above components)
- *Medium incubator involvement* (involved in two activities from one of the above components)
- *High incubator involvement* (involved in three activities from two of the components above)

4. RESULTS

The results of the interviews per spin-off are summarized in the section below and in Table 2. For further elaboration on certain variables, quotations of the respondents were added in between.

4.1 Results per interview

4.1.1 Spin-off 1

The first spin-off, categorized into *low incubator* involvement, is a company founded by academics from the chemical engineering department of the University of Twente and covers several markets in the industrial cleaning field. The technology itself originated from the Ph.D. research of the founders. Applications range from cleaning lab tools and tools in dental cleaning, and cleaning miniature parts in greater industrial and high-tech sectors. Founded in 2014 it offers not only products but also if requested by customers, consultancy services. Right now the two founders are the only employees in the company. A full-time employee and students have been employed in the past but had to be terminated due to lack of funding for the project. During the formation, the spin-off received a lot of support by the own research group and the university in terms of facility usage but also advice on the product concept and design. Changes in the product described as major were the adjustment of the external design to improve user application and offer different sizes of the product. Both changes were requested by customers. The founders applied for different funds without any consultation of external support services. The first funding was attained through the governmental STW valorization grant, which helped the spin-off in product development and the first phase of formation. Further efforts to attain additional funds failed and at this point the spin-off mainly survives on the sales it makes on their products and services.

"We are now at the deepest point of the valley of death in the sense that we got initial money from the Dutch government valorization fund phase 1 (…) and afterwards we have been surviving on contracts and sales"

Both founders obtained some entrepreneurial training by a course that was given by the research institute. The business incubator was in so far involved that contacts to the industry were partially established via the Kennispark network.

"We have tried to use [Kennispark´s] their network and talked to many people that they normally invite (…) we have not been officially part of the Kennispark or the incubation environment for a few reasons but we had good interaction"

4.1.2 Spin-off 2

Spin-off 2, categorized as *medium incubator involvement*, is a company founded by a university student and operates in the industry of consumer electronics. Founded in 2014 the spin-off now employs 15 full-time employees. Major changes in the design, as described by the founder, were electronic module parts and external module parts to mainly save on the production process.

"(…) we made a few changes to the hardware such as using different glue and exchanging different plastic materials mainly to optimize the production chain because it is still screwed in by people and people usually cost the most money (…)"

Those changes were initiated by the company itself. Further changes requested by the customer were changes and additions in the software, and the external materials such as the power cable which was too stiff and the product always fell over when standing on the cable.

"For software there is a lot of feedback coming from consumers, which we usually think is a good idea and integrate it (…)"

The first funding for the project was attained through the crowdfunding website Kickstarter. Within two days the spin-off reached its funding goal of 100.000 €. At the end of the campaign, the total funding amounted for about 200.000€ so that the spin-off could offer new features for the product such as additional software functions. Current expenses are now covered by the profit generated through sales of the product. Resources such as office space and manufacturer contacts are have based on the own network been established during the formation process. That network mainly consisted of personal contacts or own networking initiatives to manufacturers. The founder got entrepreneurial training during his studies and has already been experienced in freelancing himself by offering different web development services before. The business incubator has been in so far involved that the spin-off took legal advice from Kennispark in the formation process. At this point, the company still keeps a close informal relation to some employees of Kennispark and updates the incubator regularly on important milestones achieved.

"It this better to get your motivation [at Kennispark] there instead of learning how to be an entrepreneur (…) those guys just love what you are doing and send us cakes whenever we meet a goal (…)"

A special character within this spin-off that is worth mentioning is the board of advisors composed of experts from renowned international companies. This board of advisor mainly formatted out of personal interest showed by the industry experts. The company gathers regularly in informal meetings. As to future

perspectives, the company is planning to expand to the German market and is already negotiating contracts with two big electronic stores to distribute their product to the end consumer.

4.1.3 Spin-off 3

Spin-off 3, categorized as *high incubator involvement*, is a spin-off founded in 2015 by academics of the nanotechnology department of the University of Twente. The company covers the industry of material science and to this point employs 6 full-time employees including a business developer. The spin-off is a special case in the sample, since it does not have a finished product but rather provides a raw stage material that can be used in multiple ways within several industries. Thus, the end consumers of the raw material will be other businesses using the material to manufacture their own product. Applications range from fire retardant material production as well as exploiting the flexible property within small consumer electronics such as smartphones. Therefore, product design and finalization of the concept is strongly dependent on the customers and their desire of application field.

"We like to talk to customers and see what they want (…) we do not make a product and show it to the [customers] guys, you go to the [customers] guys and prove that you can make something (…) and then they tell you exactly what product they need"

Currently, the spin-off negotiates with several potential customers and is about to step into their first pilot project. The project has been funded by the governmental STW valorization grant in the beginning. The application for this grant was supported by Kennispark. Four months after the formation additional funding got secured through the Cotton Wood technology investment fund. Resources in the content of office space and laboratory facilities were attained via the university and Kennispark network. The business incubator has a high degree of involvement in this project. Not only it helped the spin-off to secure the STW take-off grant, but also supported the founders in terms of entrepreneurial training and is still involved when it comes to advising on business development.

"Kennispark is helping us with coaching, we can access their business developers (…) and we are also talking to them right now in terms of general questions"

The spin-off internal business developer has been experienced in entrepreneurial practices before and additionally takes efforts to push commercialization through market research and active participation in international technology conventions to expand the network to the industry.

"I have entrepreneurial experience in two start-ups that I founded before and I have been involved in various other [start-ups]"

5. DISCUSSION AND CONCLUSION

5.1 Discussion

Three spin-off companies have been interviewed and categorized based on the degree of involvement of the incubator services. The following section combines the variable of business incubator involvement and the impact on the commercialization process. The findings will be supported and explained by findings from research studies introduced in the theoretical framework.

5.1.1 Low involvement incubator spin-off

Spin-off 1 has been categorized as *low involvement incubator* customer due to the fact that it only took advantage of the network development service. Other services have been declined so far assuming that the support from the research groups would be enough. Nevertheless, due to the fact that experts from the research groups can be considered as strong ties and not the casual acquaintances Zimmer (1986) was elaborating on, it is questionable, whether those can support the knowledge acquisition about the market, customers, and investors, to a valuable degree. And although the university department seemed to possess most of the competencies comprised by Rasmusssen, Mosey & Wright (2011) and Rasmussen & Borch (2010) a key resource was missing, namely attracting an industry partner to cooperate as a champion for the project and give insights to the industry. As the spin-off company expresses itself, it is right now in the state of *"valley of death"*, that describes the phase of commercialization in which a scale up funding is necessary to continue with the business (Frank, Sink, Mynatt, Rogers & Rappazzo, 1996). The spin-off managed to get start-off funding, and although certified by the European Commission Seal of Excellence award for outstanding performance, it failed to obtain additional financial resources to push through the commercialization process and build a successful business. This struggle of passing this *"threshold of sustainability"* (Vohora, Wright & Lockett, 2004) is also reflected in the sales numbers of the product. Although the spin-off was founded in 2014 and started selling the product one year after, only 24 items have been sold so far. Contracts for future assignments have not been made since then so that future perspectives are unclear and overall question the spin-offs potential to survive. But can the lack of industry network be the only reason for the bad survival chances or do other factors play a role in here? A greater problem seemed rather be the lack of resources and, with greater focus, the lack of commitment of the founders. Barney (1991) stated that tangible and intangible resources can contribute to a firm's effectiveness. Both founders worked only partially on the project while at the same time being employed by the university as research or teaching staff. Time to engage with potential customers and dedicate time to developing networks was rare and could not have been overtaken by employees since the spin-off is a two-man company. Thus, intangible resources such as commitment were and are still lacking. Nevertheless, having contact with peer groups and networking with successful business people can have a positive learning effect on to the entrepreneurial learning process (Bandura, 1977). Furthermore, it is questionable whether the commitment is still sufficient. One of the founders works for an external company and is not fully associated with the university anymore. And has, therefore, less time to work on the project himself.

5.1.2 Medium incubator involvement spin-off

Spin-off 2 has been categorized as *medium incubator involvement* customer since it consulted the incubator for legal advice in the early phase of formation and later used business development support services. However, although covering two resource components introduced earlier, it is rather questionable whether the informal business development support of the incubator had a great impact on commercialization. In fact, the founder himself stated that his entrepreneurial knowledge did not come from the knowledge attained in the studies but was rather accomplished through own experience.

"I don't want to give any credit to the study like they taught me useful skills I know (...) I have learned to pick the right people [for my company] and to find motivation."

"There are a lot of talks about people being entrepreneurs, like the problems they face. Those [entrepreneurial events] are fun to visit, but every problem is different so you cannot learn from those specific cases."

"[During the study courses] Everyone was trying to find out how entrepreneurs work but even an entrepreneur does not know how he works, he just does stuff what feels right and then goes with it."

	Spin-off 1	Spin-off 2	Spin-off 3
Age (years)	2	2	1
Industry	Industrial cleaning	Consumer electronics	Material science
Employees (full-time)	2	15	6
Incubator involvement	Low	Medium	High
Type of entrepreneur	academic	student	academic
Business incubator involved in:			
Shared office space			
Offering working facilities (office, laboratory, etc.)	no	no	no
Network provision			
Industry network development	yes	no	no
Shared support services			
Funding/Application for grants	no	no	yes
Legal advice	no	yes	no
Professional business support			
Entrepreneurial training courses	no	no	yes
Business development advice and support (formal or informal)	no	yes	yes
Commercialization success:			
First time product sold after formation	~ 1 year	~ 1 year	~ 1 year (still in negotiation for pilot project)
Products sold	24 product items 27 service items	> 2000	none
Number and type of customers	1 distributor Number of products sold through the distributor	> 2000 consumers 5 retail partners	6 high potential (out of 40 in negotiation); business-to-business partners; none of them are private consumers

Table 2: Interview results summarized and categorized by business incubator involvement degree and commercialization success

Instead, the spin-off learned to exploit internal resources such as the own board of advisors, and approached those in times where business development advice was needed. As described by Barney (1991), the company produced a resource with value-creating character and formed a competitive advantage to other spin-offs. With this and the intuitive and explorative approach, the spin-off shows flexibility in its' working processes and thereby follows towards the state of sustainability elaborated by Bigdeli, Li & Shi (2015). Shortly after the spin-offs crowdfunding campaign the first badge of the product was shipped to the customers that account to approximately 2000 private customers at the moment. The negotiation with the retail partners gives a fruitful perspective for the spin-off.

5.1.3 High incubator involvement spin-off

Spin-off 3 has shown the highest involvement of the business incubation by not only seeking consultancy in the grant application but also training and business development. The spin-off is until now still in contact with the incubator. However, also in this third case one resource used by the spin-off earns some special attention in terms of the human resources employed by the spin-off company. According to a study conducted by Galbreath (2005) intangible resources such as organizational skills contribute significantly to a firm's success compared to tangible resources. The spin-off has its own employed business developer who is actively engaging into finding potential applications for the product and constantly talking to potential customers and industry partners. Due to his former experience in other start-up companies, the business developer can furthermore contribute a lot to the companies' entrepreneurial learning process and the double-loop process. Problems encountered by the former companies can be seen as example cases and based on that trigger the re-evaluation of the current spin-off goals and values (Argyris, 1976). Since the company is a raw material manufacturer and first prototypes of applications are still in testing, it is difficult to estimate the commercialization. Currently, six high potential customers are in negotiation with the spin-off to develop a product together. Nevertheless, the fact that negotiations are taking place already one year after the start-

up formation and a second funding was attained after 4 months, the concept proves to be a high-potential product. Based on the tangible and intangible resources available, as elaborated by Galbreath (2005), the spin-off shows high potential for success.

5.2 Conclusion

This bachelor research project focused on the topic of market engagement of university spin-offs with a closer look on to the role of business incubator services and their impact on the commercialization process of university spin-off companies. Based on the results obtained from the interviews, the initial research questions *Does a high degree of business incubator involvement show a significant advantage in a successful technology commercialization process of a spin-off compared to a low degree involvement of the business incubator?* And: *Do some business incubator activities show a greater impact on the commercialization process and thereby on the entrepreneurial learning process than others?* can be answered as followed:

- RQ1: Medium and high involvement of business incubation show a relatively positive impact on to the spin-offs technology commercialization, while low incubator involvement shows little to no impact on the spin-off commercialization process
- RQ2: Professional business support services and support in legal and financial matters show a greater impact on the commercialization process than networking and office space provision

Additional findings showed that incubator consultation would only show a valuable impact when the spin-off company itself dedicated a sufficient amount of tangible and intangible resources to work with. In the sample set researched in this study, it came across that especially human resources deserve a special attention since those showed to have a significant influence on the networking establishment of the spin-off company to industry partners and thereby gain new insights into customer preferences, market trends, and potential product applications.

6. SCIENTIFIC RELEVANCE, LIMITATIONS AND SUGGESTIONS FOR FURTHER RESEARCH

6.1 Scientific relevance

The field of business incubation has already been widely researched into many directions of impact, effectiveness, etc. (Mian, 1997; Ratinho, 2011; and Ratinho, Harms & Groen, 2013). However, research so far ignored the crucial milestones a spin-off goes through after the formation and closer observations on incubators and their impact on important milestones of the spin-off company have not been done, yet. Especially the phase of market engagement and finding the product-market fit is a crucial stage that decides whether a spin-off succeeds or not. This research makes the first step into studying the impact of incubators in those steps and gives future researchers a direction to deepen the study of business incubation in the entrepreneurial environment.

6.2 Limitations and suggestions for further research

Due to the short period of time available for researching and writing the thesis, this research study comes with a few limitations. In general, the sample size of the spin-offs interviewed was too small to draw general conclusions from the outcomes. A larger sample size is recommended to increase relevance and make a contribution to the research field.

Several factors and characters were ignored purposely to get a grip in the field first and explore relevant factors that could lead to further research. For example, the study did not seek for spin-offs from a specific field such as health technology or software, but rather accepted spin-offs from all fields. Other factors are e.g. the industry and the market the spin-off tries to cover. Spin-off 1 and spin-off 3 are both business-to-business companies making it more difficult to attain funding to push the commercialization further. Demand cannot be estimated as quickly since a deeper market research needs to be conducted and potential customers need to be contacted to estimate the interest. Spin-off 2, on the other hand, had a great advantage because it covered the market of consumer electronics and is thereby a business-to-consumer company. Attaining funding through a crowdfunding platform gave a great advantage since it reaches a high number of people. The spin-off could already forecast the demand and interest of the product amongst the consumer group. Interesting to find out would be whether the commercialization process can be expected to be faster or more successful than in the other group.

Another factor to be aware of are the types of entrepreneurs that are involved in the spin-off. While spin-off 1 and 3 both had academics in the founding team, spin-off 2 consisted of student entrepreneurs. Further research should be conducted in the sense of whether one group is in general more successful in commercializing than the other and finding out what those groups are characterized by.

Furthermore, the study only looked at one university environment and did not expand into other national or international universities. The University of Twente is known for offering a highly entrepreneurial environment and might have biased the research overall. Looking into other university environments, their incubators and spin-offs might make a difference. Additionally, this research only focused on the commercializing process moment of the spin-off. Further research should look into other phases of the spin-off and investigate the impact of business incubators in the early stages of formation or later stages when the spin-off starts to settle in the sustainable phase.

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9. APPENDIX

9.1 Interview Questions Kennispark

1) What do Kennispark services offer? Are those services rather skills-based or also practical help?

2) Is the service free of charge? If not, what are the approximate costs and how do you expect your customers to pay it back?

3) Do spin-offs approach you or vice versa?

4) How many spin-offs are approached/approach you?

5) Is there a field/industry exceptionally represented than others?

6) Do you offer contacts/network access to potential investors?

7) When is the point where you stop supporting? At what growth-stage do you let the companies continue by themselves?

8) What is the percentage of successful companies retrieved from the services/what is the percentage of companies actually having success in the market?

9) How do you measure this success?

10) Do you follow-up on the companies after you finished your services? (to keep track whether they are still in the market after some time or went bankrupt?

11) Do you follow-up on projects that did not succeed and look for reasons?

9.2 Interview Questions Spin-offs

9.2.1 General questions

The following questions are meant to get some general information about the spin-off companies that are being interviewed:

AQ1: Age of the spin-off company

AQ2: Industry of the spin-off company

AQ3: Number of employees in the spin-off company

9.2.2 Product development and the revision process

The following questions focus on the product development and adjustment phase before and after commercialization of the product:

BQ1: How often did you have to revise your product design and /or concept until the final version was set?

BQ2: What kind of changes were performed during that revision?

BQ3: Would changes count as rather minor or major changes?

BQ4: What other changes were performed to adjust the product features to the market and/or the customer?

BQ5: Were there any adjustments made to the product design/concept after the first shipment of the product?

9.2.3 Industry networks and resources

CQ1: Did you have any contact to the product industry during the product design/concept?

CQ2: How did you establish those contacts?

CQ3: In what ways did you use those contacts?

CQ4: How did you attain the funding for your project?

CQ5: How did you attain other resources such as office space, manufacturing facilities, etc.?

9.2.4 Entrepreneurial training and business development skills

DQ1: Did you possess any entrepreneurial knowledge beforehand?

DQ2: Did you receive or follow any training programs in entrepreneurship before/during the formation of the spin-off?

9.2.5 Business incubators and external business developer services

EQ1: Did you at some point consult any external advice such as business incubators, business accelerators or an external business developer?

EQ2: Would you consider to consult an external party to help you with problems in the future?