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SCHOOL OF BUSINESS, ECONOMICS AND LAW

Master Degree Project in Knowledge-based Entrepreneurship

Success Factors in University-industry Collaborations

A comparison of a research and development project

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Success factors in university-industry collaborations
– a comparison of a research and development project

By
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Abstract

The thesis addresses the concept of university-industry collaboration in R&D and how this type of collaboration should be organised in order to reach success. The thesis aim is to investigate an ongoing collaboration between a university and its industry partners in the early phases of R&D, that collaborates towards finding new areas of usage of a residual product that otherwise are used for combustion to produce energy. The thesis includes how the organisation is set up in regards of important factors for a successful collaboration and to see if reality and literature are coherent.

The thesis is a single case study that has used participant observation and interviews in order to get a deep understanding of the studied organisation. The research furthermore includes a comprehensive literature review of the specific field that provides research of factors that are seen as important in order to reach the objectives of the collaboration.

The findings clearly illustrate the complexity to organise diverse organisations within the same project. Even though the partners have the same objectives to innovate and end up with new products they have different starting points in the collaboration. Universities are profoundly different from a general industry partner since the universities main goals are to educate and to publicize results while the industry partners in general have commercial interests with a desire to patent results. Hence the complexity lies within combining the fundamental differences of the partners into common values and mutual understanding. It is a balancing act when organising the partners so that they all have the ability to fulfil their subjective goals as well as the objective goal of the collaboration.

Furthermore, it becomes evident that the reason for the industry to collaborate in this setting is not only patentability, it includes networking and knowledge transferee with a long-term point of view of innovation. It becomes clear that relationships have a profound impact on this type of collaborations where long-term relationships are desirable and often in itself an objective with the collaboration. Organisational flexibility and openness are much desired attributes of a partner in combination with complementariness since this will help bridge the gaps between the partnering organisations as well as bring a greater room for learning in to the project.

The studied collaboration is well defined and well managed and most of the success factors from the literature are represented within the organisation. The case study where analysed in accordance to the findings in the literature review and culminates in concluding that there is a clear coherency between theory and reality.

Keywords: University-industry, collaboration, R&D, open innovation, innovation process, success factors, innovation management.

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I would furthermore like to give thanks to Olof Zaring for his guidance during the work process.

Thank you!

Gabrielle Cederholm
Bohus, June 3, 2015

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1. Introduction

The following chapter will describe the selected research area, the aim of the study and the research questions.

1.1 Background

Innovation is the driver of growth, which has become more apparent among nations and policy makers during the last decades. New product development and innovation is said to be crucial in a global competitiveness perspective. Innovation is thus not only seen as important for a company internally in order to be able to conduct business more efficient, the importance of innovations is vaster and incorporates the whole sphere of the economy of a country. The ability to innovate provides opportunities for employment and welfare. The living standard of the common people has increased drastically from the time of the industrial revolution thanks to important innovations that have made production of goods more efficient. Studies have furthermore showed that a country that has a high output of innovation also has a high degree of welfare. (OECD, 2010)

To successfully bring the innovation to market there is often a need of entrepreneurial actions as well. The mere innovation will not have as great impact if it is not nurtured and promoted. Thus entrepreneurship is a driver of innovation and entrepreneurial actions is highly needed in an innovation system. (Dodgson et al, 2014) The government therefore tries to engage universities in entrepreneurial activities, with entrepreneurial actions and programmes in order to bring their innovations to the market. (Fontana et al, 2006) Universities engage with the industry for the same reason, to bring innovations to the market. But also to find innovations that the market actually needs. Many countries therefore have strategies to deal with innovations, to combine the three important elements of the innovation system: the government, the universities and the industry. (Dooely et al, 2007) These three actors are the keys to a successful innovation system of a country where the government need to give the right circumstances through legislation and the right support through public funding, incubations and so forth. A country that manages to efficiently balance these actors will evidently innovate more efficiently and thereby reach economic growth and global competitiveness.

Throughout recent history there has been a profound amount of studies of how to make organisations more efficient in regards of profitability. Not only is the organisation supposed to be effective, it has a goal of producing something that is new, something that no one else has done before in order to be innovative. (Rogers, 1995) Hence innovation can make a company successful and give the company a competitive advantage on the market. Speed of gaining knowledge can be the key to offer a competitive advantage for companies and investment in R&D has showed to have a positive impact on return for a company. (Dooely et al, 2007) Companies therefore have embraced this factor and they have started to look

outside the boundaries of the firm for partners to collaborate with. University-industry collaboration has therefore become essential for enhancing innovation in R&D efforts. However, the organisation becomes complex when it stretches over the boundaries of firms and industries. The actors are often diverse with different views on innovation and with different goals of the collaboration. (Garud et al, 2013) Organisations from the same industry can be opposites of each other's and this uniqueness brings yet another difficulty into the process of combining efforts in collaborations. The main contrast is however the difference between university actors opposite to industry actors since the university does not have a commercial interest whilst the industry almost always does.

The complexity is immense when combining public and private interest within an organisation that is supposed to bring a new product or process to market after intensive R&D efforts. Innovations usually will not just happen, it has to be nurtured in order to grow. As Fitzgerald, et al (2011) so eloquently puts it in their book "Inside real innovation", Innovation is performed by people, not organisations. This can make it tricky to innovate as innovation needs people and people need the right environment in order to work efficiently. The innovating people will be structured within an organisation and within this be able to innovate if the circumstances are the right ones. If however the circumstances are not, the innovation will be absent. It is therefore of foremost importance that the innovation process of a R&D project is well structured in order to take all parts of the innovating team into consideration.

This master thesis is based on a R&D project with collaboration between industry and university. There are nine companies and two universities collaborating towards a goal to innovate into new materials, made of residual products. The project is in the early phases of R&D with basic characteristics of the research where a potential end-user product for customers is years in the future. The partners of the collaboration are diverse and they represent the whole value chain from raw material suppliers to potential end-users as well as universities and research institutions. The diversity among the partners contributes to a complexity of the innovation process in regards of collaboration.

1.2 Problem discussion

An innovation process is present in all types of idea generating organisations, the project that this study is based upon has a very well defined idea, and a very well defined goal. Hence it is an obvious innovation process. There are obvious advantages to engage in collaborations with different stakeholders. If the collaboration is efficient the innovation process can be efficient and resources can be more efficiently used. However the complexity in collaborating over the boundaries of firms and industries is vast and focus must be put on the collaboration in itself in order to reach the goals.

1.3 Aim of study

The aim of the study is to scrutinise the research field of university-industry collaboration in order to find the best practise as currently presented. The literature of the field of university-industry collaborations in R&D will be studied in order to find success factors that can be identified to correlate to this type of organisation. The findings should culminate to give a clear picture of the current situation of the case study, how the organisation is set up in regards of important factors for a successful collaboration and to see if reality and literature is coherent.

1.4 Research question

- What factors are important for a successful R&D collaboration between university and industry actors?
- What factors are already included in the case projects innovation process?
- What implications can this have on the case project?

1.4.1 Delimitations

The thesis is limited to concern university-industry collaboration, thus not handling innovation processes in general. However some factors has implications on all types of innovation processes and thus they will be of interest in this thesis.

2. Research method

The following chapter will outline the method, research approach and the course of action of the study, including data collection, data analysis and reliability and viability discussion.

2.1 Research strategy

Strategies are the plan forward in order to reach a set goal. Thus the research strategy is the plan for the researcher in which the path towards the goal of the study is described. (Saunders, 2012) There are different kinds of research strategies and there are several parts within the strategy that need to be stated, the research objectives will be the basis in which the research strategy will be based upon.

2.1.1 Qualitative research

Research is often divided between qualitative and quantitative research. A simplified distinction between the two types of research is that a quantitative strategy focuses upon quantification, to quantify the findings. The qualitative approach on the other hand emphasises words when collecting and analysing data. (Bryman et al, 2011) This thesis will follow a qualitative approach due to the nature of the objectives of the thesis. The qualitative strategy gives more flexibility than the quantitative, concepts can be derived from collected data and applied in accordance to the objectives.

2.1.2 Research purpose

The research purpose can be explorative, descriptive or explanatory. (Saunders, 2012) Information at hand prior to the research in combination with the research objectives will be an indicator to what type of research will be needed. The research purposes are however not exclusive and thus the research can have more than one purpose over time as it develops.

Descriptive and explorative research purpose is what best describes this master thesis. The aim of the research is to extract success factors in university-industry collaboration from the literature and to analyse the case project in the lights of the literature, which gives a need of finding relevant literature to analyse in accordance to the given project. The literature is not as developed in the specific area of university-industry collaboration in a R&D projects as it is in the literature in project management and general innovation processes, hence there is a need to analyse existing information in accordance with the unique collaboration setting. To comprehensively answer this question there will also be a need of interviews with the stakeholders to be able to fully establish their preferences of the processes. As there will be an analysis of both existing theory and own conclusions the descriptive in combination with the explorative purpose will be used.

2.2 Research design

The research design is set up as a single case study that focuses on a whole organisational collaboration in a R&D project. Case studies suit the explorative purpose and the qualitative approach. Furthermore it will be a single case study since only one particular organisation will be studied. The diverse stakeholders are seen as a part of the organisation and will therefore not be studied as one organisation or in one specific case. This case study will foremost be framed theoretically to apply the knowledge gained on the specific case organisation.

2.3 Data collection

The sources of data collection for this thesis are divided into primary and secondary data. Primary data is the type that has been gathered through first hand contact during the research process. The primary data that is used is interviews and observations. The secondary data of the thesis is information generated from other research, this study will be based on scientific articles.

2.3.1 Primary data

2.3.1.1 Semi-structured interviews

The research is based upon nine interviews where a semi structured interview approach was used. The semi structured approach was chosen in order to firstly get answers to some generic information about the participants in the project and secondly to get a deeper understanding of the interview target. It is helpful in order to get answers from the stakeholders on the same areas that will be seen as critical in order to fulfil the objectives. Furthermore it will highlight other facts that the interviewee feel are important for the project or for their own processes within their companies and thus give a richer answer than a structured interview would.

The study tried to cover the whole organisation of the studied project of university-industry collaboration. Thus one representative from each organisation was asked to participate. The project management team, who mostly consist of university members was of interest as well with a focus on the manager, coordinator and one senior supervisor as they all have their own specific part within the organisation.

2.3.1.1.1 Interviews

The aim was to interview one representative from each organisation. However, three of the industry representatives were unable to attend to an interview. Therefore interviews were held with six companies and with three key persons in the board, one of them the manager of the project. Three of the interviews were conducted on phone and six in person.

Organisation	Role	Date	Time
University	Manager	2015-04-27	33min L
University	Coordinator	2015-04-10	35min L
Research institute/University	Senior Supervisor	2015-04-13	25min L
IP-A		2015-03-25	47min L
IP-B		Unable	
IP-C		Unable	
IP-D		2015-03-31	40min P
IP-E		2015-03-31	15min P
IP-F		2015-03-23	42min L
IP-G		2015-03-24	18min P
IP-H		2015-04-24	43min L
IP-I		Unable	
*IP = Industry partner		P = Phone	L= Location

Figure 1. Interviews with key persons

2.3.1.1.2 Interview guide

The interviews were prepared with an interview guideline after conducting basic research on the area. The basic research functioned as a basis for the understanding of the field and thus a guide for where the interviews needed to head. The questions where further grouped according to the different parts of the organisation it touched upon. Follow-up questions were asked when appropriate according to the situation. The combination of the questions changed somewhat depending on what institution the interviewee belonged to. The free nature of the interview gave the interviewee room to elaborate on matters they felt they liked to explain, thus some questions were never asked to some interviewees since they had already elaborated on the matter.

The interviews were held after a presentation of the master thesis for all the partners on a project meeting, further introduction was made to those who had been unable to attend to the meeting. The interviews were held at a location chosen by the interviewee or by telephone in those cases were the interviewee was located too far away. The interviews were initiated with questions about the roles of both the interviewee the organisation he/she belongs to and the roles within the project. The second part was inquiries of the structure of the organisations such as who does what, how often are there meetings and how they

communicate. The goal of the interviews was to understand the different objectives among the partners. The third area of inquiries was about processes, how they do things practically, does all partner contribute the same amount, does everyone have enough time set aside for the project etc. And the fourth part was about innovation, the perception of innovation, how they look upon the innovation to come from this collaboration and how they handle intellectual property rights.

The interviews had an important role in highlighting the use of learning and feedback lops in the project. It was important to get a story from each part of the organisation to fully understand how the project is perceived among the partners. Furthermore it was interesting to see if there was a discrepancy between the partners' goals and visions of the project.

2.3.1.1.3 Interview transcription

All the conducted interviews where reordered in order to be able to listen to the interviews at a later stage and to transcribe them. The transcription was conducted by writing down the exact statements of the interviewee so nuances in the language were kept. The transcription was then used to categorise the answers to fit into the categories from the literature.

2.3.1.2 Observations

There are according to Saunders (2012) two types of observations, participant observation and structured observation. The structured observation is focused on quantifiable matters, thus correlating to the quantitative approach. The participant observation correlates to the qualitative strategy, it includes to let the researcher be a participant of the activity. The essence in observation is recording, description, analysis and interpretation. (Saunders, 2012) The participant observation was used in this thesis where participation was made at a project meeting and sub group meetings at the 12th of mars 2015. Extensive notes were taken, both of scientific matter discussed as well as interaction between the participants. The notes was then analysed and structured together with the answers from interviews.

2.4 Secondary data

Secondary data is often extracted through a literature study which can be narrative or systematic in its nature. The narrative review is intended to provide the researcher with a broad overview of a topic. It does not need to follow a systematic approach towards finding the literature which makes it likely to be biased, thus the authors might choose literature that supports their hypothesis. A systematic literature review is a review of the evidence of a clearly defined question. It uses systematic methods to select and evaluate primary research. In the systematic literature review the relevant information from studies that are included in the review is extracted. It includes a systematic and comprehensive search for relevant articles, based on specific key words. (Bryman et al, 2011)

The secondary data that has been used within this study is foremost scientific articles and other important literature in the field. The literature review is narrative in nature and the sampling was made by a focused search in databases and a snowball sampling method. The method was to firstly find important literature in the field and after that use forward citations of the articles, which provide new articles that are based on main concepts. The main database used for citation search is *web of science*. *GUPEA* has been another database used for findings of relevant articles. The search after relevant articles has been conducted with combinations of key words such as *university-industry* combined with *collaborations, success factors, best practice, innovation, and R&D.* The used search method is however subject for a sampling biased. The articles that were chosen have been so due to own subjective preferences of the field. Even though an objective approach towards the collection of articles has been used biased can still be a factor in the sampling.

The use of a narrative literature review with a snowball sampling method for a master's thesis is superior to a systematic literature review in a couple of areas. The systematic approach is time consuming, and for a master's thesis time is not of abundance. The reason to its time consuming nature is that research criteria's are made and all articles within this criteria's will be shown in a search in a database. Thereafter the researcher needs to go through the various hits and decide which to include in the review, all hits need to be evaluated and it can be thousands. It furthermore could potentially lose some important information since year could be one search criteria which would not include older material than what is chosen, and ground breaking articles might be excluded. The time criteria is however important in a systematic review in order to both get the latest results as well as a manageable sample. Therefore the snowball sample is a much more time saving method that includes relevant material in most searches.

2.5 Data analysis

The data analysis is conducted by a narrative approach where theory and empery are analysed together in a continuous process. The analysis was a factor during the process of data collection which provides opportunities to iterate during the process when a need of modification and additional planning of further data collection become apparent. Iteration can therefore occur from the analysis phase back to a data collection phase. The narrative approach is beneficial in order to gain a deeper understanding of the studied case, and it is appropriate for a study that uses observations, interviews and secondary data.

2.6 Reliability and validity

The quality of the study is assessed through validity and reliability. (Bryman et al, 2011) There are two concept of reliability which referees to external and internal reliability. The internal refers to the coherency between observations and theoretical ideas. External reliability relates the generalizability of the study which often is an issue in qualitative studies since

there are small samples and case studies. Bryman et al (2011) explains that it is almost impossible to freeze a social setting, and qualitative studies are often based on social settings. This study is in many ways a study of a social phenomenon. Problems if the study needs to be generalizable can therefore be that the partners in the collaboration might change, representatives from the different organisations might change and so forth. Even the observations and the interviews are hard to conduct and get somewhat the same results since people might answer differently when the project has come further ahead. Moreover, to use only one case as representative for a general phenomenon will not be enough. One case conducted by interviews and observations is likely exposed of subjective choices in the research process and thus not easily generalized. However the literature of the thesis should be fulfilling the requires of the external validity even though a structured approach would have been better for that reason, though not feasible due to time issues.

Furthermore, to asses that the interviews gave real information of what actually is and not what the vision of the different organisations are the interviews were conducted in a conversation rather than in a sequence. A sequence would have been easier to structure in an analysis but important information can be hidden when there are no room for elaboration.

To ensure the validity transcriptions were made of the interviews and then systematically organised according to the questions. This method is time consuming but it does ensure that the true statement is kept. All interviews were made in Swedish which is the reason why quotes has not been used. When translating into another language meaning can be lost in the same way as when rewriting sentences.

The research strategy of the thesis was to go back and forth between the findings and to make adjustments when needed, which reassures the internal validity of the study.

3. The fundaments of innovation theory

The following chapter will outline the basic concepts that are fundamental for the thesis area of research and for the understanding of the complex nature of innovation processes and innovation management in general that ultimately will provide an understanding of the complexity of collaborations within this type of setting.

3.1 Basic concepts

3.1.1 Innovation

A common belief is that innovation as a topic has emerged in recent years, but the phenomenon has rather gained popularity recently. (Bessant, 2003) The word comes from Latin's *innovare* that means to renew, alter or to make something new and it was used in this sense already in the Roman Empire. (Narayanan, 2001) There is no definite consensus within the literature of what the word innovation entail, with small nuances of differences of the meaning that has developed over time.

Joseph Schumpeter was the one to bring the concept of innovation into light in the early 30s and it has since evolved from the industry sector and advanced into the service sector in more recent years. (Narayanan, 2001) Schumpeter made a distinction between innovation and invention which in his theory is that an invention is a combination of already known components, Innovation on the other hand often includes an invention but it has more to it. Schumpeter's theory includes five classifications of what innovation can be:

- An introduction of a new product or a qualitative change in an existing product
- A process innovation new to an industry
- The opening of a new market
- Development of new sources of supply for raw materials or other inputs and
- Changes in industrial organisation. (Rogers, 1995)

Innovation was in the 60s and 70s defined to be "a unit of technological change". Joseph Schumpeter was the greatest influence to these early views where technology and production were in focus. Dodgson et al (2008) however describes innovation as the creation of a new idea that has successfully been exploited and commercialised, including all parts of the path towards commercialisation such as organisational, technological, financial and scientific etc.

The distinction of innovations and the categorisation of different types of innovations are many, however the most prominent distinction is the distinction between radical and incremental innovation. (Dodgson et al 2014) This distinction is based on the degree of change that the innovation give rise to. The incremental type of innovation is more common as there are smaller changes of already existing subjects. Radical innovation involves a completely new idea. Radical and incremental innovation has much to do with the level of

change. Radical innovation is a more invasive process with at greater need of investment of both time and money. (Dodgson et al, 2008)

There is furthermore the much used distinction between product and process innovation. Product innovation is often the first type of innovation that comes to mind as this type is the one developing and evolving new types of goods to the market, with technology as a prominent key factor. Process innovations on the other hand develops the organisation, processes, internal tasks and ways of working and are not as easy to see for the common customer. (Dodgson, et al 2014)

Despite all the different views of innovation all of them have in common that it is a highly complex process to end up in innovation. They furthermore agree upon that innovations are important cornerstones in society. Therefore many authors conclude that innovation need monitoring and nurturing in order to be developed. (Dodgson et al, 2008. Bessant, 2003. Rogers, 1995)

3.1.2 Research and Development

The diversity and fast evolving nature of business and product development increases the need of new innovations. At the same time the cost of innovation is rising parallel to the increasing effort it takes for research and development (R&D). (Sandberg et al 2013) The R&D expenditures in the US for R&D in pharmaceuticals make a good example of how R&D has changed. The R&D expenditure has risen but the FDA approved drugs are in contrast at a historical low. (Munos, 2009) The pharmaceutical sector used to contribute with new ground-breaking innovations even with little efforts after conducting R&D in a serendipitous manner. The effort is now greater and the numbers of innovations are smaller due to the complexity of the field. This development enlightens the complexity of R&D. It becomes more costly and firms have started to realise that it is not financially viable to do all the needed research in-house. They understand that they do not need to invent the wheel again if someone else has the knowledge that they are willing to share. (Annique Un, 2014) Thus firms acknowledging that collaborations towards the same research agenda can be a much more fruitful method in their efforts towards new inventions.

The traditional view on research is divided into basic and applied research. The role of the basic research according to this point of view is to provide the industry with a well-established ground of research. Vannevar Bush (Narayanamurti, 2013) is often cited as the one to introduce the concepts of basic and applied research and he argues that it lies in the governments' interest to provide the industry with basic research.

Basic research is a broader more fundamental type of research. It goes back to the understanding behind material, natural processes and basic concept of the studied area. Applied research is more focused on a specific area and the innovation (or invention) in this type of research is often something hands-on. It is said to use the basic research as a foundation of the applied research. However, basic research does not have to come before

the applied research. There are many examples in history of how applied research came before the basic understanding behind the innovation. One such example could be how the first man discovered fire, the physical laws were understood long after. However, the basic research is an important factor in most applied research as it often becomes the stepping stone for the more focused research, the understanding of the basic properties is a help forward in the research in itself.

Some authors believe however that the view on research as being divided in basic and applied research is too definitive. It is often seen as the government should found as much basic research as possible and let the firms found their applied research themselves that will be based upon the basic research. The boundaries between the two types of research are seen as to simple and unhelpful among these authors. (Narayanamurti, 2013) They argue that the only way to make sure that the research institutes contribute with findings that will help the nations' is to have a holistic approach to the funding decisions and thereby have a long-term plan for the R&D on a national level.

It is however clear that R&D is important for the welfare of a country. Ground-breaking innovations in general take 10-15 years of research and development to become commercialised.(Fitzgerald et al, 2011) Therefore it is the research projects from the previous decade that is supposed to be harnessed now. It is of this reason important to grant research as it is a long and complex process of R&D before it becomes an innovation.

3.2 Innovation management

Innovation is both the output as well as the process and it is people that innovate, not organisations. (Fitzgerald et al 2011) The innovation processes are always present in organisations that encourage new ideas. It is present on different levels and kinds of the organisations. Some organisations do not know that they do innovate and thus they do not know that they have an innovation process that could benefit from nurturing. However, other organisations are painfully aware of this fact where they make great efforts in order to become more efficient. The complex nature of innovations makes the process become complex as well.

3.2.1 The evolution of innovation management

The theory of innovation processes as well as the term innovation has developed over time. Rothwell wrote the article "Successful industrial innovation: critical factors for the 1990s "*in* 1992 and "Towards the fifth-generation of innovation process" in 1994 both on the issue of how innovation processes has evolved over time. Rothwells view on the innovation process has through these articles become a cornerstone in modern innovation theory. Rothwells work describes five generations of thinking of the innovation process. It illuminates the differences in the point of view of the innovation process and how it has evolved.

The first generation of innovation processes from the 1950s is considered to be based on a technology push, it is assumed that innovation is linear and that the market will use the innovation. The innovation starts with what is possible and brings this to market notwithstanding if the market wants it or not. The strength within this model is that the innovation can end up in radical innovations.

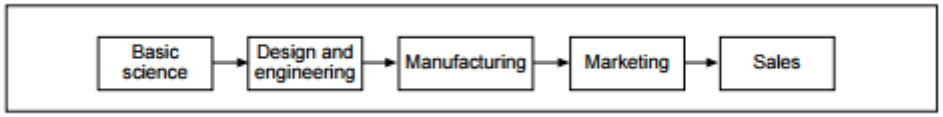

Figure 2. First generation of innovation (Rothwell, 1994)

The second generation was prominent in the 1960s and draws upon the view of market pull, i.e. the market demand will be the influence of what will be innovated. The process is seen as linear but with the market that initiates the idea. The innovations are often incremental since the market often does not know exactly what they want they can only influence it in an incremental manner and thus make already existing innovations become better

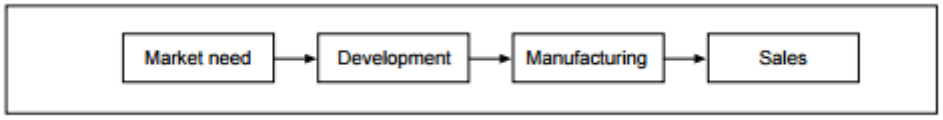

Figure 3. Second generation of innovation (Rothwell, 1994)

The third model of the 1970s has both the demand and the pull point of views. It is called the coupling model and it is not seen as a completely liner process. This model has a feedback and communication system that is supposed to function in both directions. It is not necessarily a continuing process and communication is a key within this setting. This fairly simple model can provide both radical and incremental innovations, and the model has incorporated an extensive feedback loop as the communication is seen as highly important within this model.

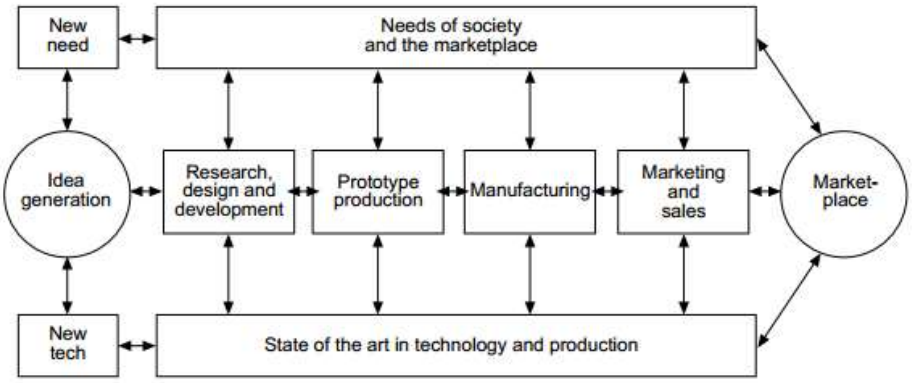

Figure 4. Third generation of innovation (Rothwell, 1994)

The fourth generation is called the integrated innovation process and it was prominent during the 1980s and early 1990s. It had become clear how time was a factor of successful businesses and concepts such as just in time became important. Extensive external networking activities became vital and made room for collaboration with suppliers in product development. Integration of partners and parallel development was key issues. Companies strived to be able to conduct different parts of the processes in parallel as had been seen in innovative Japanese companies. The ambition was to get different department to conduct their activities simultaneously, a process that has been called the rugby-approach.

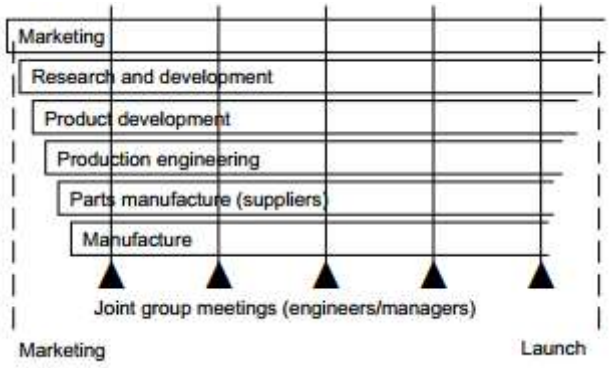

Figure 5. Fourth generation of innovation (Rothwell, 1994)

The fifth generation is the last model from Rothwell which at the time was more of a forecast of what will come next. Factors that had become more important were speed to market, to be first on the market with an innovation and to gain competitive advantage.

One of the most important factors of the fifth generation is learning. Learning both internal as well as external is key issues for well performing innovation processes. It is a learning process which has long-term benefits for the organisation. Another important factor is how information is handled across the organisation. The process is coloured of parallel information sharing with both traditional face to face communication as well as formal electronic communication.

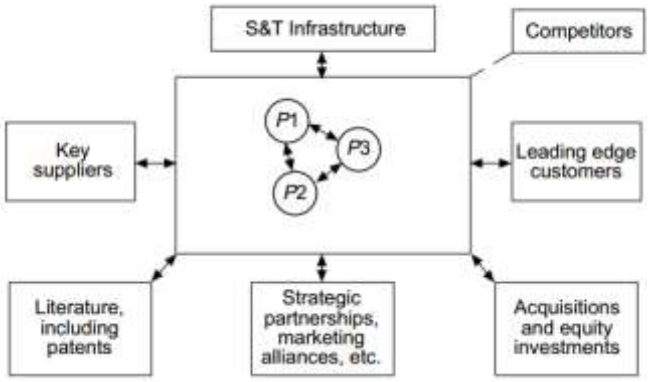

Figure 6. Fifth generation of innovation (Rothwell, 1994)

All of these models are however simplified but they do illuminate the basic point of view of how the innovation process has emerged from a liner structure into an iterative process. However, even though Rothwell identified the shift in mind-set of the innovating landscape, the literature on innovation processes continue to be influenced with a linear thinking. It is furthermore mostly influenced of new product development. A reason why the linear process is still used is the purpose it serves as to ensure that important factors are implemented as decided in advanced. Every phase of the process has its own objectives to full-fil. The innovation process as a whole has two goals to fulfil, the main goal is to end up with an innovation and the second is to do it within budget.

3.2.2 New product development

New product development has been influenced of a need of innovating fast. Chen et al (2012) however identifies the importance to instead do it right from the beginning, thus supporting the mind-set which Rothwell described in the fifth generation. Cooper et al (2002) argue that the most successful companies uses well-defines criteria's in their decision making process which he calls a stage-gate process. The stage-gate theory is widely used in product developing companies since it is useful in order to split a project in to smaller pieces. The theory starts its journey in the discovery phase where ideas are developed and then screened, if the idea passes the gate it will be further developed in the process. Every gate functions as a screening where the idea is scrutinised to investigate if it has the right properties for the next stage and evidently if it is feasibly to take the product all the way to launch. The gates function as a port where the project can be terminated if it does not fulfil the criteria's, the function of the gates are to evaluate ideas in order to sort out bad ideas from good ones. (Cooper et al, 2008)

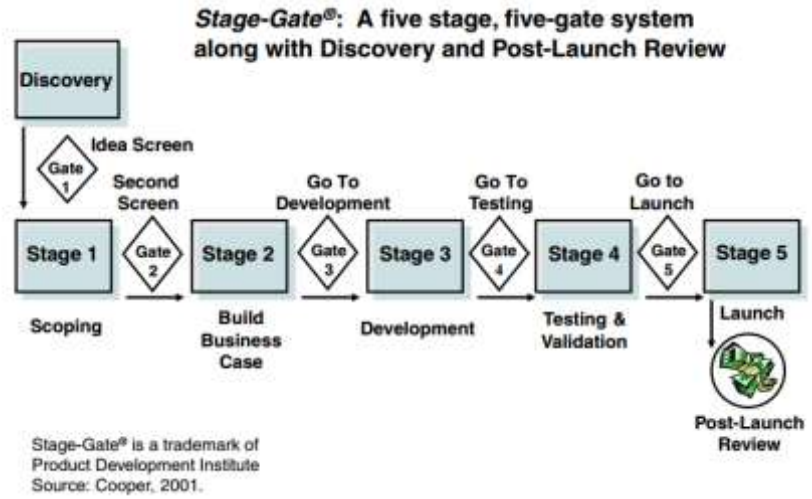

Figure 7. Stage-gate model (Cooper et al 2008)

3.2.3 Iterative innovation process

The innovation process is according to Fitzgerald et al (2011) about handling three different factors at the same time, theology, market and implementation. An iterative innovation

process can look and feel messy at first glance, however it is according to these authors the real path toward successful innovation as it is a more efficient process. The iterative process is a process that reduces waste. It gives early indications when the course of action need to be revised and thus waste in a long-term thinking is kept at a minimum. It is better to determinate the projects early before development has started to be too serious and too costly.

Technology

Technology corresponds to the early phases of the linear model, such as development of a invention. It includes both new and old technology that can provide insights in the innovation process. This part of the innovation process is generated of all types of technology, R&D and novel ideas. Most innovations re-use old technology but in a new setting.

Market

The market relates to the end users, but it is important to learn from the market already in the beginning. As was evident already in Rothwells third generation of innovation, the customers does not always know what they want. But the market need is important to investigate potential usage, important properties of a specific product and other information that the market can provide. Success in the innovation process increases when the process is kept as open as possible early on.

Implementation

Implementation is what needs to happen in order to join the technology and the market together. It delivers the innovation to the market. Thus IP, financial viability, innovation management, skilled researchers, etc are important factors in the implementation.

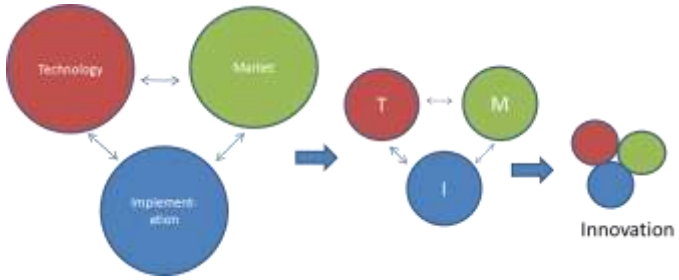

Figure 8. Iterative innovation process (own construction based on Fitzgerald et al, 2011)

The iterative innovation process is applicable on all types of innovation processes, including universities efforts toward innovation. The idea generation is a important part of the innovation process where the traditional models for innovation processes focuses on idea generation in the beginning of the project. Several different ideas are evaluated and one or a

few are chosen to be developed in the next step of the process. Naturally ideas are often the starting point of an innovation process as well as an important ingredient during the process. The idea generation of a R&D project in the early phases need to be more open than the traditional innovation process suggests, with a "think outside the box" approach where new ideas need to both be generated and considered. In the early phases of R&D it is impossible to know where the research will end up and to close in on only one idea that seems to have great potential can be dangerous since the R&D might not accomplice this pre-set goal or the market might not need the innovation even though it is highly complex, new and promising. Another danger of being too focused on one idea can be that it is not scalable outside a laboratory. Thus the idea generation ability needs to influences the whole process, from the initiation of the project and onwards. Thus the modern approach towards innovation suggests that several prominent ideas at a time should be researched so that the chance to get one innovation to market is increased.

3.3 Open innovation

Chesbrough presented open innovation in his book "Open Innovation: The New Imperative for Creating and Profiting from Technology" a ground breaking book from 2003. Open innovation is based on the notion that a firm can and should use both internal and external recourses in order to innovate.

The classical type of innovation in companies is when firms have extensive R&D in-house, with clever people in a well-developed R&D department. The innovation process was kept secret with both formal disclosures of secrecy as well as corporate secrecy strategies to ensure that competitors would not gain access to the much valued knowledge that been discovered in the internal R&D efforts. Therefore it was highly important to have the best and the brightest people in-house, both for the sake of the own company as well as for the reason that competitors should not have them.

In the view of open innovation however, the boundaries of the firm has loosen up. The new paradigm of open innovation make the firm realises that it is not possible to have all the smartest from the field in-house and acknowledge that great ideas can come from other sources as well. Thus instead of closing the boundaries of the firm with secrecy and in-house

Contrasting Principles of Closed and Open Innovation

Closed Innovation Principles	Open Innovation Principles
The smart people in our field work for us.	Not all of the smart people work for us* so we must find and tap into the knowledge and expertise of bright individuals outside our company.
To profit from R&D, we must discover, develop and ship it ourselves.	External R&D can create significant value; internal R&D is needed to claim some portion of that value.
If we discover it ourselves, we will get it to market first.	We don't have to originate the research in order to profit from it.
If we are the first to commercialize an innovation, we will win.	Building a better business model is better than getting to market first.
If we create the most and best ideas in the industry, we will win.	If we make the best use of internal *and* external ideas, we will win.
We should control our intellectual property (IP) so that our competitors don't profit from our ideas.	We should profit from others' use of our IP, and we should buy others' IP whenever it advances our own business model.

Figure 9. Closed vs open innovation (Chesbrough, 2003)

knowledge the boundaries are open up to knowledge exchange and collaborations between actors.

Figure 10 describes how ideas in the innovation process are internal, where no ideas can come from outside of the firms boundaries. The process is described of an innovation funnel, where there are more ideas in the beginning of the innovation process that closes in on one or a few at the end of the process. Figure 11 describes how ideas come across the boundaries of the firm and thus creating more ideas that would be possible from the internal organisation. When closing in on ideas at the end of the process there can still be used

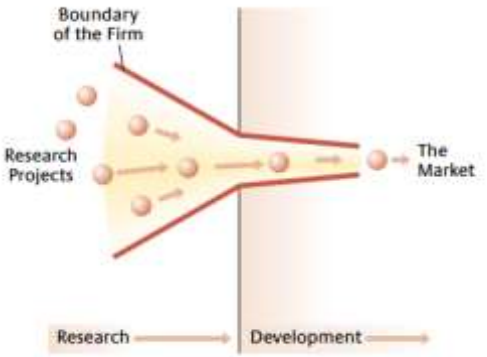

Figure 10. Closed innovation (Chesbrough, 2003)

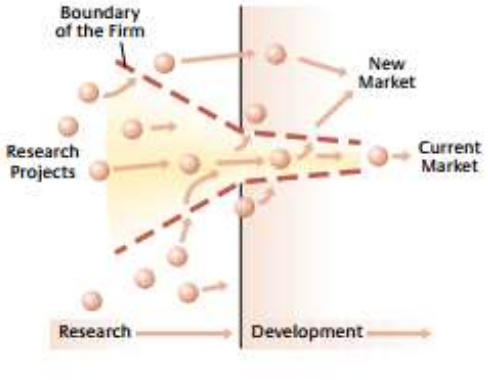

Figure 11. Open innovation (Chesbrough, 2003)

knowledge from across the boarders and thus

When changing strategy into open innovation it is however wise to keep the internal R&D department, even though it might not have to be as extensive as before. Studies has shown that open innovation has had the best impact on those who involve themselves in collaborations as well as developing own internal R&D. (Roper et al, 2012) When firms involve themselves in open innovation efforts they get several benefits such as a reduced risk in the innovation process. Instead of bearing the whole risk of the project with all costs involved they can bear a small part of it where others do the same. Thus the lost in a unsuccessful project will not be as demanding as it would have been with a traditional research project. Furthermore, the quality of the innovations can be enhanced and especially the time of the project can be shortened. Knowledge-spill over is another contributor to the positive effects of open innovation, where new knowledge can be used together with old internal knowledge into a new innovation. (Roper et al, 2012)

The fierce competition on the market, always growing and evolving has been a factor in the change of the view of the innovation process. The fast changing market and the growing competition has forced companies to have to change their innovation strategy. The closed innovation process is costly as it is based on the best and the brightest in the field which is costly to acquire in house, furthermore the secrecy forces the firm to become top of the class

even in sub divisions of their research and not only in their target field. Open innovation provides the firms with the opportunity to get "ad-hoc" access to personnel, since collaborations will provide them with the right people for that setting. (Alexander et al, 2013)

University industry collaboration can be seen as open innovation depending on the nature of the research. The term would be private open innovation or open source innovation depending on how the outcome of the project would be promoted. (källa)

3.4 Summary

Innovation has showed to have impact on firm performance, however the innovation process is a complex process to organise. The literature covering innovation processes focuses foremost upon innovation within a firm. Even open innovation starts the journey within a specific firm and actors contributing to the open innovation does it in a way where the openness is more focused on looking outside the company rather than setting up an innovation process with others. However emphasis is put on the uniqueness of different organisations, and it is the different attributes within the organisations that decides which innovation process that will be best functioning. There is differences among the different types of frameworks where some are still linear and some are completely iterative.

The innovation process is a complex balancing act where opportunities are at one side and risks at the other. The literature tries to bridge the gap between the two so that the opportunities can be realised even though there is risk within the calculation as well. The extensive literature within the field illuminates the fact that there are different means to reach the goal of innovation. However no matter what innovation theory is used to organise an innovation process most has come together around the notion that feedback is important. The modern innovation theory emphasis the feedback loops wetter this feedback is conducted through an iterative innovation process where all parts of the innovation need to be juggled at the same time or if it is through feedback in a stage-gate theory with gates that can either terminate a project or let it into the next phase.

4. Success factors in university-industry collaborations

The following chapter will present a literature review focused on factors that can be of importance for university-industry collaborations in R&D. The chapter presents important factors for a well-functioning collaboration.

Alexander et al (2012) points out that success is a subjective term opposite to performance. Thune (2011) has the same understanding that there is not a single definition of what success entail within university-industry collaborations. The reason to the complexity in defining success lies in the complexity of combining partners that are as fundamentally different as universities and industry partners are. The partnership is defined by being a heterogeneous setting where partners has different activities and time horizons which makes it likely that they have different perception of success. Thus it can be seen that there exists two types of success within these collaborations, the subjective and the objective success. Therefore factors contributing to realising both or any of these objectives can be called success factors. Some factors that can be seen as success factors might not have any direct influence of the outcome of the project.

4.1 Collaborative framework

The literature covering the specific area of industry-university collaboration in R&D projects divide the process into three areas that all need to be maintained carefully to reach the best results of the collaboration. The three areas are contextual, process and organisational factors each consisting of several pieces that need to be in place in order to get a successful. A further discussion is made of what a successful collaboration actually entail. Success factors often differ between academia and industry, thus it is a challenge to find a path within the collaboration that can lead to a successful collaboration for both parts.

4.1.1 Contextual Factors

Contextual factors are central factors for the initiation of the collaboration and for the formalisation of the collaboration. It consists of factors such as which partner to choose, previous experience in the team and geographical proximity.

4.1.1.1 Selecting partners

One important factor when initiating collaborations is to choose whom to collaborate with (Mora-Valentine et al, 2004. Barnes et al, 2002. Speakman, 1996). It has importance since the partner is likely to be there throughout the whole process of the collaboration and thus influencing the whole project.

When looking for a partner Thune (2011) suggests that the openness of the firm should be considered. The openness relates to wetter a company are willing to share information, technology and expertise. Barnes et al (2002) highlights this factor as one of the most important factors to consider in the establishment of a collaboration between university and

industry since university-industry collaborations are a form of open innovation where the research is dependent upon some sort of sharing of information.

Reputation can be an influencing factor in choosing a partner (Thune, 2011). This is especially true when industry expresses interest to collaborate with universities. Industry partners have showed a greater interest when there are an experienced senior researcher with a good reputation and track record within the research team. The importance of these individuals has been evident in cases where industry partners have left the collaboration after an experienced researcher decided to leave. These researchers has been seen as key persons in the collaboration. Thus it is important both to have someone with a reputation in order to get the desired partners into the project but it is of equal importance to have a team that the partners are willing to stay with if this person decides to leave.

Furthermore, the whole organisation of the potential partner should be analysed before initiating the project. There should be a holistic approach in the evaluation of the organisation in order to grasp all parts of the organisations and to understand if there are any structural changes or other fundamental factors that can contribute to an unstable organisation. An unstable organisation can have profoundly negative effect on a collaboration project. The impact of an unstable organisation can result in a change in whom will represent the company in the collaboration. Partners thus are preferred to be sound and balanced in order to provide the best fundament for the collaboration. (Barnes et al, 2006)

Not only is it the stability of the organisation that is important when holistically scrutinising it. The culture and overall fit within the project has impact as well. (Barnes et al, 2006) Language is one factor related to culture that can be a barrier within a collaboration. (Joshi et al, 2014) Furthermore complementary competences are important, where an overlap in knowledge can bridge the gap between the different fields and provide the group with an understanding of one another. (Thune, 2011) Alliances should be based on actual complementariness. (van der Valk et al, 2010) Collaborations with a diverse set of partners lead to a greater learning possibility which can enhance innovation performance. (van Beers et al, 2013)

In general studies have showed that collaborations with universities has a positive impact on innovation. Studies on collaborations with suppliers and competitors however has gained diverse results where some believe it to be positive and some negative. (Kang et al, 2010)

Previous experience influences the choice of partner and is therefore an important factor due to two reasons. Many partners have been reluctant to involve themselves in another collaboration project after being in one that they have perceived as unsuccessful. On the other hand partners who have been in an collaboration which they saw as successful made them more likely to actively search for another project. Furthermore, previous experience of collaborations has shown to be beneficial as partners who have previous experience becomes more flexible as well as more understanding of limitations and competences needed in the

project. (Barnes et al, 2006) Thus previous experience is important in both directions as it can be helpful in establishing new collaborations as well as be the main factor that a sought after potential partner will not attend the collaboration.

Studies have shown that firms who often collaborate with others in different project have a higher likelihood to become successful in their collaborations. They are able to transform the knowledge gained from different collaborations into value in their own firm. (Bruneel et al, 2010)

4.1.1.2 Geographical proximity

Some authors mention geographical proximity as one potential success factor. Arguing that long distance is dangerous for the collaboration, as face to face meetings is the most efficient form of meetings. The closeness could be a factor in strengthen the relationships among the partners. (Thune, 2011)

However, other researchers conclude that geographical proximity does not have any impact on the collaboration in itself. (Pertuze et al 2010) Laursen et al (2011) argues that it on the contrary can be cost efficient, promoting new technology to be highly efficient for long distance collaboration. Mora-Valentin et al (2004) argues that there are no significance of geographical proximity in the lights of a successful collaboration. They argue that the meetings in themselves will be the determinant factors of the success, not the distance. This relates to the finding that face to face meetings seem to be conducted approximately the same amount of times notwithstanding the geographical distance. (Pertuze et al 2010) In cases where there are great distances companies often send their representatives to stay for an extended stay, thus giving the companies the same type of opportunity as companies located nearby. (Pertuze et al 2010)

Geographical proximity is diversely discussed in the literature and it seems that most authors point toward that geographical proximity can be a barrier in finding new partners. It does not however have to be a problem for the collaboration when it is established as long as the process is well managed.

4.1.1.3 Objectives

Shared vision and shared goals would be the best scenario for a partnership. (Bender et al 2000) However, it is rare that all partners have the same objectives, values and visons. Often in firm to firm partnerships there are the same vison of gaining competitive advantaged, where the partner becomes an asset that will complement the firm with new competence. When the collaboration is between a university and industry the competitive advantage is not as important for the university as they often has the objective to find results that might not necessarily contribute to competitiveness on the market. Dooley et al (2007) points out some key drivers to why universities and industry are willing to collaborate.

University key drivers

- Access to additional research funding – Additional funding to the traditional funding can contribute to increase knowledge and deepen the competencies as well as a more stable research environment.
- Access to proprietary technology – Access to this type of technology can increase the time to discovery as well as lowering the costs for research.
- Enhanced status – If the university are able to provide evidence that research output can effectively be delivered to the public and thus a contribution to the economy of the country they are more likely to get other public funding due to a good reputation.
- Faster feedback loops – The findings of the research can be evaluated faster in collaboration with the industry.

Industry key drivers

- Access to scientific competence – Universities is often niched in their competences which can be beneficial for a company if they are weak in the research area.
- Access to knowledge (tacit and explicit) – universities accumulate knowledge that is sought after by the industry. All knowledge is not easily transferable through a public paper and therefore interaction is important in order to gain the knowledge.
- Acquire competitive advantage – when interacting with universities the industry get to know the results before they are published which gives an edge compared to the competitors who has to wait for the result to be published.
- Recourses and skills – Collaboration with universities can be cost efficient due to facilities which universities often possess. Also access to academics is important.

Even though these key drivers are compatible there are many issues to resolve before the collaboration can be conducted efficiently. The underlying objectives are still fundamentally different since the university almost always has the objective to publish meanwhile the industry partners in most cases has the objectives to commercialise the research results. To combine the different point of departures it is important that the partners can communicate their vision and their objectives in an understandable manner, so that everyone understands one another's objectives and thus can work together for a mutual goal even though the goals might be different. (Bruneel et al, 2010) The future success of the project is dependent on mutual understanding and common values, not on mutual set goals. (Speakman, 1996)

4.1.2 Organisational factors

The organisational factors of the research collaboration are factors that relates to the organisational structure. Degree of formalisation and resources are examples of the organisational factors. The collaboration can be informal or formal in its nature, short or long-termed, a strategic partnership etc. The organisation will be designed out of these factors.

4.1.2.1 Formalisation and agreement

Collaborations take different shapes and forms and they can be long-term or short-term in nature and the degree of formalisation can differ as well. Informal collaborations can be equally successful as formal ones depending on the partners point of departure. However, the degree of formalisation is an important factor to consider before entering a collaboration project since there are different objectives and various resources etc within the different organisations.

When establishing collaboration projects between university and industry partners there are often a need of formal agreements that establish the ground rules. This agreement can be shaped differently whit more or less details. Burnside et al (2008) points out the importance of getting into agreement before too long where they point out that contractual discussions often become vicious circles that tend to have a negative impact on the collaboration. Companies often have their eyes set on getting a waterproofed IP agreement resulting in prolonged discussions. Prolonged discussions are time consuming costly and a threat to a good relationship. Therefore it is important to manage the contractual agreement as efficiently as possible. Burnside et al (2008) therefore suggest having a focus on practical issues that are likely to appear rather than to make the agreement waterproofed. They furthermore suggest that the IP discussion should be by held itself so that the other issues regarding how to collaborate will get a greater focus in the discussions. Emphasis should lie on the actual need of their partners. (Thune, 2011)

4.1.2.2 Commitment

Commitment is important from all partners but it is especially important from key persons in the collaboration. (Barnes et al, 2006) The key persons are important both in the establishment of the collaboration as well as the continuing collaboration process. They help to keep momentum which is important as collaborations spanning over industry boundaries are faced with difficulties such as partners having other projects as well. Lee et al (2010) point out that commitment from key persons can be helpful in order to overcome difficulties in the collaboration. The commitment can furthermore be helpful in the discussions when establishing a formal agreement. (Thune, 2011)

Special skills and complementary knowledge can enhance the commitment of the project since different partners will have different responsibility and special expertise. When the partners feel that they can contribute and that they are important in the project it is more likely that they will continue to be a contributor in the project and their commitment are then at a consistent level. (Bender et al, 2000)

Another success factor is when the project has one individual that is especially committed to the project and has some sort of influence over the project. This individual is called collaboration champion by Barnes et al (2006), and this person influences the other partners to become more committed as the collaboration champion will spread the enthusiasm to

others. (Mora-valentine et al, 2004) However, it can be a danger in depending of one person too much. As always when depending on one person it can have the opposite effect if this individual decides to leave for some reason. The effect of the collaboration champion is however great if they stays in the project. (Thune, 2011)

4.1.2.3 Recourses and skills

Recourses and skills are both key factors in a R&D process. Financial support, (Bender et al 2000) social capital (Thune, 2011) and infrastructure (Chen et al, 2012) are important factors for a successful collaboration. Social capital is all types of human resources in the collaborations such as PHD students, senior management, project leaders etc. The research process has potential to become more efficient if the university has a well-established research team.

External financing has proved to have a great impact on new innovations and research findings. External financing can improve the licensing and royalty income according to Lach et al (2008). Furthermore when all partners in the project have agreed to contribute financially and with human capital the expectations of the project rises among the partners. (Thune. 2011) Higher expectations lead to higher commitments which can lead to a greater impact on the research. (Mora-Valetine et al, 2004)

When collaborating with external organisations there is a need of complementary expertise to avoid knowledge gaps as well as to find synergies in the collaboration. Individual skill has proved to have an impact on the overall performance of R&D projects. Furthermore complementary assets are important as well in order to use resources efficiently. Complementary facilities can help the project keep costs low if investments can be avoided due to existing resources in the team. (Bender et al 2000)

Furthermore, in order to use time, skills and resources efficient it is important to plan the project carefully. In R&D projects where objectives cannot be clearly defined due to the projects delicate nature it is of foremost importance that the project plan is efficient so resources are well spent and waste are keep at a minimum. Clear roles and responsibility as well as a work plan has showed to be of benefit for this reason. However, the work plan need to be sufficiently detailed and realistic for the partners to follow it, otherwise there are a risk that the work plan will be ignored and becomes rather an obstacle than a help.

4.1.3 Process factors

The process factors are related to the process of how to achieve the goal of both the university and the industry partners in the collaboration. Important factor for the process is management skills, good communication and a well-established relationship.

4.1.3.1 Management skills

The management of the organisation influences the whole process from budget to quality of end product. Skills and experience of the project manager are important factors for the success of the project. (Thune, 2011) This success factor becomes evident during the execution of the collaboration. (Barnes, 2006) In a case study conducted by Barnes et al (2002) it becomes evident that inexperienced project managers had a negative effect on the project, whilst experienced ones had a positive impact. This is supported by Speakman et al (1996) as well who suggest that important alliances always should be led by an experienced manager. They propose that small alliances with less at stake could be led by an inexperienced one but not important and vast alliances. Weak management of a project can easily lead to a loss of engagement in the project, especially between industrial partners. The pre experience is required both in terms of academic experience as well as industrial experience. (Barnes et al, 2006)

Management skills as a success factor is not unique in this type of collaboration, it is one of the mentioned success factors in all types of venture creations as well. (Barnes, 2006) The project manager has a diplomatic role where meddling between the partners is a crucial part. The role does not entail actual authority thus making the meddling part crucial in order to reach goals and make sure that work continues.

A successful collaboration project can be dependent on previous experience. (Bruneel et al, 2010) The collaboration process is likely to be run more efficiently if there is some experience of handling both the relationships between the partners as well as the work process. It is furthermore a contributing factor to develop both trust and thereby opportunities for a successful collaboration (Thune 2011). Researchers are more likely to understand the needed effort of a collaboration if there are previous experience (Hall et al. 2000). Pertuze et al (2010) acknowledge that success of the collaboration is more evident when the researcher has experience of working within the industry or a similar one before, since this contributes to an important understanding of the other organisation. Furthermore, studies have shown that the relationship between the partners can be enhanced if the project management is shared between academy and industry since this leads to an enhanced understanding among the management team. (Barnes, 2006)

Boundary spanning is supposed to be the link between the organisation and the outside world. (Lee et al, 2010) One person is often the boundary spanner of the organisation that has the role to obtain outside knowledge that will be distributed among the partners. Lee et al (2010) suggest that the boundary spanner should be formally selected. The boundary spanner need to possess great knowledge in the field, have willingness to network between organisations and have the ability of opportunity recognition for the project. Thus the boundary spanner can be the same person as the manager of the collaboration, given the factors mentioned. (Pertuze et al, 2010) It is important that the boundary spanner

continuously visits companies and that the boundary spanner shares knowledge gained at these occasions. The boundary spanning function can also be used to overcome cultural differences that can be profound in industry university collaborations. A study conducted by Lee et al (2010) provides insights to how formal boundary spanning can be beneficial in both the formation of R&D collaborations as well as for expanding the scope of the collaboration.

4.1.3.2 Communication

Communication is a key success factor. (Chen et al, 2012) The project is endangered if the communication does not work since the communication is a factor to make sure that all partners know what to do as well as know what has been done. Communication is furthermore the factor at heart when partners discuss new ideas and processes. (Mora-Valentine, 2004) Thus with a well-functioning communication new ideas will have easier to be researched and implemented. (Barnes, 2002) Problem solving is another factor that depends on a well-functioning communication, where it is important that problems can be ventilated openly in the organisation and discussed without pre-judgement. Communications is a means in the building of trust (Chen et al, 2012) and in the understanding of each other's objectives. The partners need to communicate in order to gain mutual understanding, and the communication need to be somewhat regular for the best result. (Pertuze et al 2010)

In university-industry collaborations it is often the knowledge exchange that is one of the drivers of the project. Communication is a key success factor for the knowledge exchange. There is no legitimate rule to how the communication should be set-up, however there are some factors outlined in the literature that can be used to improve communication. Face to face meetings, personnel exchange, visits from university partner to the firms, modern communications tools such as telephones, video conferences, and email. However, the face to face meeting is the highest regarded one. Speakman et al (1996) points out frequent face to face communication to results in less confusion. However over communicating is not good either, to have too many meetings face to face could be seen as a waste of time and it could be a factor in lost commitment to the project. When partners in the project are geographically distant modern technology can be helpful in order to maintain the regular communication and use face to face meetings more seldom.

4.1.3.3 Relationships and Trust

Many innovations wold not have been realised or would have come to the market much later if there had not been different types of university-industry collaborations. (Fontana et al, 2006) For this reason the relationship between university and industry are of great importance. However, universities and industry innovates on different time scales. They furthermore have different aspects in their innovation processes with different objectives. Therefore it becomes even more important to establish long-term relationships between the two. In a study conducted by Pertuze et al (2010) they found that in 80% of successful

collaborations there had been a previous engagement in R&D collaborations. Perkman et al (2007) concludes that relationships and learning often are the main reasons to why firms engage in collaborations. The tangible outcomes such as IP licencing are seen as a secondary objective for most firms. This leads to the conclusion that it is important to nurture the relationship between university and industry. Perutze et al (2010) suggest that the university should visit industry partners at some occasion, since that leads to a stronger bound between them. Furthermore, a high level of trust will encourage the openness of the companies and thus enhance the relationship. Trust need to be built already before work has started as it will minimise potential problems during the execution phase. (Barnes, 2006)

Brunel et al (2010) finds in their study that the most important type of relationship is the informal relationship in the organisation. Where the trust is low it is likely that partners' will be reluctant in sharing information. On the contrary, where the informal relationships are good information is often shared in-between meetings and has been a success factor in many collaborations. This relates to the benefits of past experience especially past experience of working together with one particular partner. Then there is already a level of trust within the project which will be helpful to establish trust in-between the other partners as well. (Barnes, 2006) Where past experience is lacking a good track record from other projects can be beneficial in order to establish initial trust and confident in the project and the partners.

4.1.4 Threat to success in collaboration

There are plenty of potential threats to an innovation process in general, and when it is a collaboration over industry boundaries and between academia and industry there are yet more potential threats much due to the partners different objectives and different organisational structures.

Cultural differences are seen as one of the prime threats to a successful collaboration between university and industry. (Barnes et al, 2006. Dooley et al, 2007) Cultural are a fundamentality of an organisation and the reasons to why and how work are conducted are not always explicit. The differences are often enhanced due to different objectives driving the organisations, ownership is another trigger of culture where publicly funded organisations often get another culture than private. Cultural differences can lead to a lack of understanding of the counterpart and misunderstandings as well as frustration among partners. Cultural differences are hard to overcome but a good relationship and a formal agreement that the partners feel are suitable for the project and that they are willing to follow where they realise that compromises might need to be made can help to overcome cultural issues. (Dooley et al, 2007)

As pointed out earlier, mutual understanding is crucial for the project. The project is in danger if the partners do not understand the others objectives. The danger herein is that one partner might not follow the same "rules" as the others. Such as only trying to gain information and never share own information, or try to set the research agenda towards their

own preferred goals etc. (Barnes, 2006) Hidden agendas are according to Barnes et al (2006), the single most important reason to why collaborations fail.

A project can also be in danger if the workload is too heavy for one or more partners which often happens when a person have more than one project at a time to focus on. The commitment form this person can be low and thus contribute to the wrong type of engagement in the project which can negatively influence others. Furthermore, not enough time for the project can also be costly since the project might be prolonged. (Barnes et al, 2006)

4.2 Knowledge transfer

There is yet another important factor within collaboration and innovation, learning and knowledge transfer. When open innovation is embraced within an organisation it is of foremost importance that the knowledge exchange is functioning. It is the basic fact where the open innovation is built upon. Knowledge and information is not interchangeable, information is the flow of messages' and knowledge is what happens when information is used together with previous knowledge and information. (Nonak, 1994) Thus knowledge transfer is yet another important factor for the university-industry collaboration. To engage in knowledge transfer for a business is a strategic decision that can bring value to the organisation. (Alexandera et al 2013)

There are two important distinctions in knowledge transfer literature:

- *Explicit knowledge* - is defined as the knowledge that can be transferred by data, words and numbers which makes it easier to share.
- *Tacit knowledge* - is regarded as "know how", the knowledge that derives from both cognition and interaction. Action, commitment and involvement are three components which can determine tacit knowledge. Michael Polanyi said - *We can know more than we can tell.* (Nonaka, 1994)

Tacit knowledge is regarded by Alexandera et al (2013) as essential for innovation. Many authors discuss the ability to share tacit knowledge where some argue that it is impossible or at least very hard to share. However the study by Alexandera et al (2013) suggest that tacit knowledge can be transferred and the best way to do so is by face-to-face interaction or by other forms of so called rich media.

Knowledge within an organisation is created continuously in a dialogue of tacit and explicit knowledge (Nonaka, 1994) Nonaka presents a framework for knowledge conversion that explains how knowledge can be transferred. Nonaka emphasis how people can acquire tacit knowledge without verbal interaction, this is the first mode of the knowledge conversion framework called "socialisation". Experience is important for both transferring and acquiring tacit knowledge, which in a business setting becomes important that the partners have some shared experience so that they can be able to take in the knowledge. The mode

"combination" is when explicit knowledge is brought together, which can happen fairly easy in a business setting. The other two modes have a combination of both explicit and tacit knowledge where the tacit knowledge needs to be more articulated. When knowledge is allowed to become articulated it is easier to transfer it. (Nonaka, 1994) Joint creation of knowledge through interaction and sharing of experience is the important action needed in knowledge transferring. Joint efforts create synergies of greater knowledge for both parts.

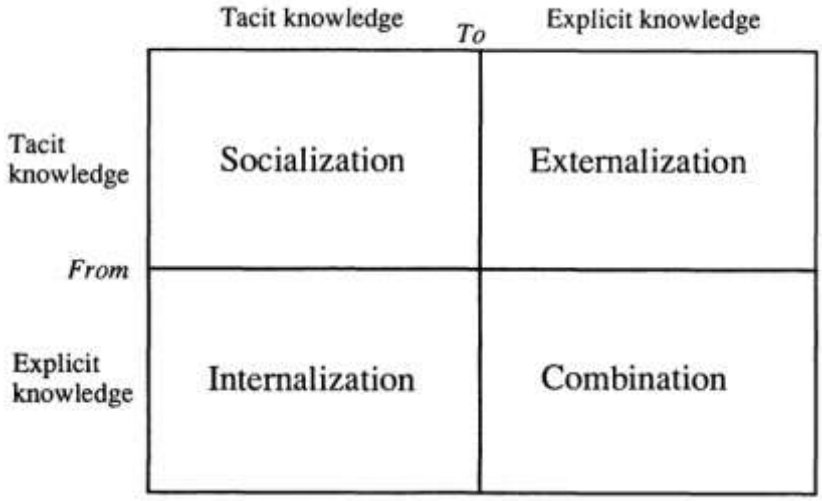

Figure 12. Modes of knowledge creation (Nonaka, 1994)

Organisational and managerial factors have proved to be important in university-industry collaborations in regards of knowledge transfer. (Siegela et al, 2003. Lakpetch et al, 2012) Knowledge transfer between university and industry can be improved when the university understands what the industry need. It can be further improved when there is a flexible approach towards the negotiations of agreements of the collaboration. Furthermore, formal boundary spanners are mentioned to improve a successful knowledge exchange as they can be a part in the process to loosen up the boundaries between firms and universities that can be influenced of their different objectives of collaboration. (Siegela et al, 2003) Factors such as the willingness to learn have important implications for the process, an organisation with individuals that have a clear willingness to learn will have a higher likelihood to acquire new knowledge. (Lakpetch et al, 2012) Close relationship within the collaboration can positively influence the transfer of both tacit and explicit knowledge. (Razak et al, 2014)

4.3 Summary

The literature review has given examples of important factors for university-industry alliances. Where Thune (2011) has been a great influence to the organisation of the factors within categories such as contextual, organisational and process factors. This study has somewhat reorganised Thune's framework in order to incorporate factors that other authors found important as well. The success factors of university-industry collaborations are firstly related to the contextual factors that relates to the mere context of the collaboration. They are

to choose the right partner for the project, manage geographical distance efficiently, and align the different objectives within the project. After the initial stage of the contextual factors there are organisational factors such as to decide degree of formalisation of the project and to set up agreement for the partners, enhance commitment among the partners, and make sure there are enough resources and skills in the collaboration. In order to succeed with this the process factors are important, to have a manager and a management team with the right skills, to communicate efficiently and to build relationships and trust among the partners. In order to succeed with the collaboration however there is yet another factor that needs to be in place which is knowledge transferee. It should be continually ongoing throughout the collaboration. Knowledge transferee is in itself a goal with the alliances.

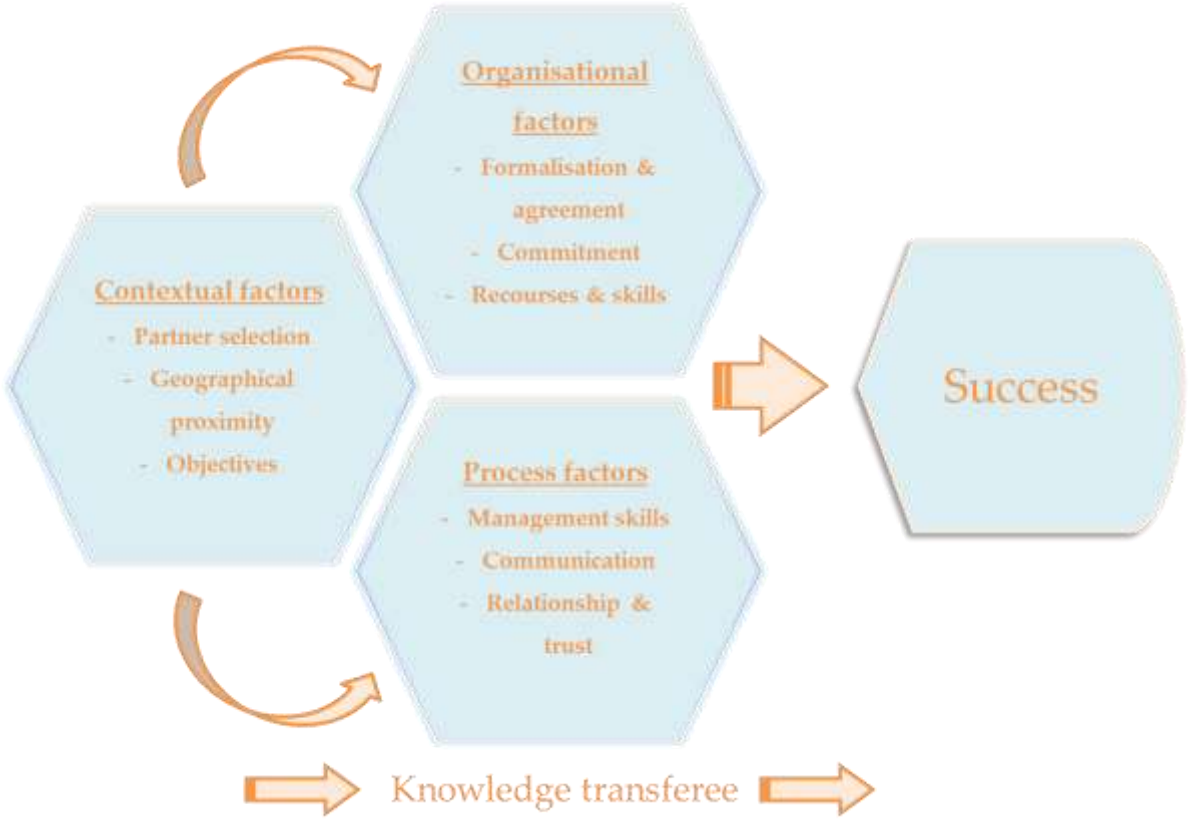

Figure 13 University-industry collaboration - success factors (own construction)

To manage these success factors the literature has identified additional factors that have impact on the collaboration and that contributes to success. These factors are organised as sub success factors to the main success factors seen in figure 13. Some of the sub-success factors are the same in different categories such as complementariness, openness, flexibility, face to face meetings and previous experience. These factors are therefore important for the success of the project. The sub-success factors will be summarized in the next table.

Success factors	Sub-success factors
Partner selection	***Openness*** – The partner need to be willing to share knowledge and information. (Thune, 2011) ***Flexibility*** – The partner need to be flexible in order for the partnership to work. ***Previous experience*** – Previous experience can have great impact since the partners has learned what it entails to be in an alliance. This can enhance openness and flexibility. (Barnes et al, 2006) ***Complementariness*** – It is the dissimilarities in the project that is important, to be able to complement each other's. (van der Valk et al, 2010) Stabile organisations – The partners need to be stable so that instability does no negatively influence the project. (Barnes et al, 2006)
Geographical proximity	***Face to face meetings*** – The distance can be a problem, but with fruitful face to face meetings it can be mitigated. (Mora-Valentin et al 2004)
Objectives	***Mutual understanding*** – It is important to understand the other partners objectives, but the objective does not need to be the same. (Speakman, 1996) ***Common values*** – Shared values will help the organisation (Bruneel et al, 2010)
Formalisation and agreement	***Flexibility***- A flexible approach towards the contractual discussions is important in order not to get stuck in a vicious circle. (Thune, 2011) ***Focus on likely practical issues*** – A focus on practicalities that are likely to arise is more important than to focus on making the agreement. (Burnside et al, 2008)
Commitment	***Committed key persons*** – If the key persons are committed it is likely that their commitment will influence the others to become more dedicated which will likely have an positive impact on the end results. (Barnes et al, 2006)
Recourses and skills	***Complementary*** – Recourses and skills should be complementary in order to get as broad competence in the project as possible. Some overlapping competences can however be beneficial. (Thune, 2011) ***Social capital, infrastructure and financial support–P***eople and facilities are needed to be able to conduct the research efficiently where thought need to be given to (Bender et al 2000. Chen et al, 2012)
Management	***Previous experience*** – The project manager will be more likely to bring the project to success if they have previous experience of similar situations since this will enhance understanding and flexibility in the project. (Barnes, 2006. Speakman et al 1996. Thune 2011) ***Boundary spanner*** – The function of a boundary spanner can help bridging gaps between university and industry (Lee et al 2010. Pertuze et al, 2010)
Communication	***Face to face meetings*** – Meeting face to face minimizes misunderstandings. (Speakman et al 1996) ***Email &video conferences*** – A good complement to face to face meeting, it should not be exclusively used. ***Do not overdo it-*** Too much communication can make partners loose interest in the project and stop taking in information when given. Important information should be communicated and preferable at pre-set times. (Chen et al, 2012. Mora-Valentin et al 2004)
Relationship and trust	***Long-term point of view-*** Relationships should be built over time. (Perutze et al (2010) ***Previous engagement in R&D*** – When there is a long-term perspective in relationships trust will be built and the likelihood of engaging in collaborations more than once is higher. Collaborating in different settings with the same partners helps to further build the relationship and previous engagement provides understanding for the process and the partners. (Perkman et al 2007) ***Visit the industry partners*** – When the management team visits the industry partners the relationship is maintained and deepened. (Perutze et al (2010) ***Openness*** – Openness helps to nurture the relationship and the relationship nurture openness. ***Informal relationships*** – Informal relationships can help the formal ones. And they are often one factor in sharing knowledge that would not have been shared otherwise. (Brunel et al 2010)
Knowledge transferee	***Boundary spanner and mutual understanding*** – The boundary spanning function to bridge gaps between the partners which help the mutual understanding. When the partners have mutual understanding it will be easier to assimilate knowledge from the others. (Siegela et al, 2003) ***Socialisation*** – Is important to share both tacit and explicit knowledge. (Nonaka, 1994) ***Willingness to learn*** – Organisations has easier to learn if they are willing to learn. (Lakpetch et al, 2012)

5. Case study

The current situation of the studied organisation will be presented in this section. The findings within this chapter originate from observations, interviews and documents provided from the organisation.

The case project will be completely anonymised due to the delicate nature of the research. There will be no specific presentation of the research since this has no implications for this master's thesis, the focus lies on the collaboration and not on their research. The partners in the project will only be presented shortly with approximate size and role in the project.

5.1 Organisation

The case project is an R&D project with collaboration between industry and university. There are nine companies and two universities collaborating towards a goal to innovate into new materials, made of residual products. The residual product is usually used for combustion for energy since there is currently no other area of usage for it. Thus the idea of the R&D project is to hopefully be able to use material in a more sustainable manner. The project is in the early phases of R&D with basic characteristics of the research where a potential end-user product for customers is years in the future.

The partners in the collaboration are ranging from raw material suppliers to end users in the supply chain. Thus there are different levels of contribution to the project due to the companies' diversity as well as to their internal abilities. There are however no direct competitors among the companies and the project is partly publicly funded and partly funded by the partners. The contribution is however not solely monetary, a contribution can also be in the form of workforce, material or infrastructure.

The idea came to life from another R&D project at the university in which many of the partners already collaborate. This other collaboration will be mentioned as the parallel project since it is an ongoing project that has been influential for the project that this study is built upon.

5.1.1 Partners

The following will consist of a short description of the different partners in order to understand the different sizes of the firms and where they can be described to be in the supply chain.

University – The lead university are a well renowned university of technology, known to have a high standard on both education and research. The university has the coordinating responsibility and the project management role. The university has post-graduates whom conducting the main research in the project. There are furthermore bachelor students writing their bachelor thesis for the project.

University II –The second University is also known for a high standard on education and research. It is a specific institution that is part of the collaboration that has a focus on social science, and more specifically on business and management. Their role in the project is to evaluate the process and to be an objective part of the research that objectively looks into the project without any education in the research field. They are thus a silent partner in the collaboration focusing on the softer parts of the research and will therefore not be further mentioned in the thesis.

Research institute – The research institute are a governmental institution driven as a company. They conduct business with both Swedish and foreign companies and they have offices around the country. They employed 1435 people in 2014. The representative is both employed by the university as well as the institute and the nature of the research institute is more alike the university than the industry partners. The role the research institute has is to conduct research, and post-graduates use their facilities and the supervision of the representative.

Industry partner – A are an international company with activities in more than 80 countries and they employ about 55.000 people. They represent a potential raw material supplier however, this project is not directly connected to their current products, and it is therefore a project that can broaden their product base.

Industry partner – B are a Swedish company with business in the Nordic countries. It is small and family owned with 8-9 employees.

Industry partner – C is a small one-person Swedish company.

Industry partner – D are a Swedish company owned by Swedish farmers, they have 8.000 employees and they conduct business in about 20 countries. Their role in the project can be both providers of raw material as well as to be end-users. Their diverse and complex structure can be a great asset in the project where their spokesperson has a doctoral degree in a relevant field for the research.

Industry partner –E are a Swedish company owned by Swedish farmers with business in seven countries, they have 500 employees and 300 of them in Sweden. They are a raw material supplier in the project since their regular activities produce the type of residual material that the project tries to use.

Industry partner – F are a Swedish company with business in 90 countries and they have 7.400 employees. They represent a potential end-user in the project where they potentially could use the innovation from this project within their current products and thereby replace the current materials in their products which are made out of non-sustainable materials.

Industry partner – G are an industry network. They have around 250 companies and organisations as members and they employ about 9 people. Their role in the project is to be a

link between the project and the industry and to represent a commercial part of the project. They represent potential end-users in the project, which would use the potential innovation in their products. They can answer questions such as what does the industry need and what is seen as attractive in the eyes of the industry both now and potentially in the future.

Industry partner – H are a Swedish company with business in around 100 countries and they have in total 44.000 employees. They are the last company to become part of the collaboration even though they were contributing in the initiation of the early planes of the project. Thus they are a partner in the parallel project. Their role in the project is of end user character where they can contribute with knowledge of potential products for the hoped innovation.

Industry partner – I are a Nordic company with production in Sweden, Finland and Germany, they employ 30.000 people and they represent the raw material provider in the research project.

5.1.2 Organisational structure

5.1.2.1 Project board

The project has a board with representatives from all of the different partners. The board is the highest decision-making organ and they have the last saying in different matters. The board decides for example who will be able to become a partner in the collaboration. They meet when there is an issue to discuss, not on a regular basis.

5.1.2.2 Project management

The project management team consist of five persons, whom are all from the university. One of the members is both employed at the university as well as at the research institution. The management team are led by a project manager who has experience from similar types of collaborations, whom also has other parallel similar projects. Furthermore there is one post allocated to an administrative person, the coordinator of the project. Who has a degree in the required research field but does not conduct any research within this project. They meet about every second week in order to establish progress between the research groups as well as to discuss the way forward. The industry partners are welcome to join in these meetings which have however not happened yet.

5.1.2.3 Sub-groups

The project is divided into eight sub-groups, each with different goals, people and technical methods. Each sub-group is led by a senior scientist. They conduct research in different fields which all will be of interest for the project and ultimately all the research will be brought together.

5.1.2.4 Project meeting

A project meeting is held two times a year it for all partners involved. At this meeting there are general presentations of the work that has been done since the last meeting and the progress that has been made. It is foremost post-graduate students that present their findings and their process for the partners.

5.1.2.5 Reference group meeting

The reference group meetings are an arena where the participants can discuss issues of the project. The issues can be all things relevant for the project, thus not limited to science but strategy can also be a part of the discussions. The reference group meeting is a complement to the project meeting where the reference group meeting is thought to be the arena for enhanced discussions, where details can be scrutinized. The goal is to receive ideas and help in matters that are problematic. Furthermore, interest from the industry can guide the research work. The reference group meeting is held approximately two times per year and it is not mandatory for the participants in the collaboration to attend, however it is the best arena to give input to the work process.

5.1.2.6 Contractual agreement

The collaboration is built upon openness between the partners and it is built upon the common interest of reaching new materials. Therefore it is an important cornerstone that all results from the project are seen as common result to them all. However if there are someone who feel they want to patent any results from the efforts they will be able to do so. The patenting process starts with one month to decide whether or not they would like to investigate if they want to patent the discovery and then three following months for decision and filing for the patent. Those who like to file for a patent will cover the cost to do so and the other partners in the collaboration will continue to have a free licence to use the patent in the future. The IP agreement is bound of a contract between the partners which entail more details for the collaboration.

5.2 Observations

5.2.1 Project meeting

The project meeting was held on 12th mars. Representatives from most of the partners were present, however not from IP-B, IP-C and IP-E. The meeting had been formally announced both on the last meeting as well as to all the partners a month before, with the agenda attached.

The meeting was held in an open spirit, where a guest speaker from another prominent university in Sweden held a inspirational speech about a closely related area of research. Time was given after the presentation for discussion among the listeners about the topic of

the guest lecture. Both industry and university partners were inspired and impressed of his work and there were a lot of questions regarding his research and results. The guest speaker shared his work and he was also helpful for the project in itself when he gave advice to the postgraduate students after their presentations of their progress. The postgraduates were the main focus on the meeting, as they were presenting their work, what they have been doing and what they will do, where they have had problems and where they might have problems. However, the discussions where brief and concise, and there were mostly two companies that distinguished themselves in the manner of sharing and discussing which was due to their specific knowledge in the research field.

5.2.2 Reference group meeting

After the project meeting there were two reference group meetings. At this point a lot of the participants had left for various reasons. The reference group meeting was a recap of what the postgraduates had been presenting during the project meeting, but with the difference of being a deeper explanation and discussion. The room for discussion was much wider and direct questions was asked from the postgraduates to the industry in order to know if they were heading towards the right path. At this point there was a clear discrepancy between the participating partners. IP-A had a lot to share and gave advices in almost all the questions and discussions. This partner made facilities and tools available for the postgraduates as well. The research that was discussed was this particular partners own expertise which explains his edge in the discussion.

The university representatives and the postgraduates together with the IP-A was those who was most frequently discussing the issues at hand. The other industry partners mostly had to look thing s up in order to answer questions, as this was not their area of expertise, however they were all willing to come back with their answers at another time. All in all the meeting was open and friendly where they on occasions went “around the table” to see that everyone who had something to say really did so before moving on to the next subject.

5.3 Interviews

In order to better understand the collaboration and the organisation as well as the incentives for the collaboration interviews were conducted with both industry partners as well as university representatives. The interviews has been summarised and answers has been categorised in accordance to the categories in the literature study.

5.3.1 Contextual

5.3.1.1 Selecting partners

The university in combination with the research institution invited the partners into this collaboration. They asked organisations whom had already been collaborating in projects with them before. And many of the partners are currently collaborating on the parallel

research project lead by the university. There were other potential partners that were asked in the beginning of the project as well, whom the university or the research institute had not been engaged with before that decided not to take part in the project even though they seemed interested from the beginning.

However IP-G is somewhat an exception, they are not a partner in the parallel project as many others are and they were not invited by the university. They instead asked if they could become a part of the collaboration after seeing a notice in a scientific paper about the partnership. However, they did have some previous experience of collaborating with the representative from the research institution.

All partners have some previous experience of collaborating in R&D projects before, both with some of the partners in the collaboration as well as with other partners. Within this collaboration there are no one that are completely new to everyone. Five of the partners, the university and the research institute are collaborating in the parallel project. The other partners have other experience with either the university or the research institute. There are examples of partners who has been collaborating with other universities where they have been the only industry partner as well. Thus the previous experiences among the participating partners are fairly considerable.

5.3.1.2 Geographical proximity

The distance among the partners are not seen as a barrier in the collaboration at any level. However, it is a contributing factor to why some are not always able to attend the project meetings. The partners are located at different parts of Sweden, however not further north than Stockholm. When someone are not able to attend the option of participating over internet can be arranged.

5.3.1.3 Objectives

The universities objectives with their activities are divided into three: to educate, to research and the third objective that is to engage in innovation and provide the industry with knowledge. Within a collaboration such as this all three objectives can be fulfilled such as letting post graduates be educated. Engage in research and invite the industry in their efforts.

IP-A has the vision of the collaboration to bring new knowledge to the table. They do not have the objective to get patents out of the collaboration, however a patent would as well be welcome. Their hopes with all their collaborations projects are always to gain new knowledge which they look upon as basic research so that they can use the basic research in their applied research. In combination with all their projects and their own R&D they want to commercialise on the research, however not on the basic research that can come from the project.

IP-D was straight forward in their explanation of their objectives and vison of the collaboration. They want to be a part in the project so that they can commercialise on the innovations in a nearby future of five to six years. Their main reason to be a part of the collaboration is thus commercial interests where they acknowledge the researchers from the university to be some of the best researcher in the country and therefore of good potential for the collaboration. They furthermore like to see synergies of their internal projects when possible, so that the innovation can grow faster in their different settings.

IP-E has commercial interests in the product and their main goal with the collaboration is to be able to broaden the scoop of their current products. Their ambition is to use their material more efficiently which this project in a best case scenario could contribute with.

IP-F mentioned networking and relationships to be the main factor why they collaborate in this type of setting. They do have a commercial interest and they prefer if the collaborations lead to an innovation, however their understanding of innovation is that it appears out of planed luck and therefore they do not put all their hopes into one project.

IP-G has no objective what so ever to claim any rights to the innovations made in the project. They have no need and no want of the innovation as such. Their objective with the collaboration is to be a spokesman for the project in their industry network. They believe that the project can have opportunities that are important for their members and it is for the member that they work.

IP-H has as main objective with the collaboration to end up in new innovations which they can use in their products. Their ambition is to always be in the forefront of innovation in their field and therefore they have chosen to collaborate within this project since they can see a potential of the research to contribute with high value for their organisation.

5.3.2 Organisation

5.3.2.1 Formalisation & agreement

The time for the formalisation of the agreement took about six months, and the project had already begun at some levels when it was finalised. The parallel projects agreement was the foundation of this projects contract that was changed to the current needs of the participants. The IP agreement is a standardised method that the university often use and one partner has already looked into potentially filing for a patent when the researchers found a new method for a process. However that method showed to already have been described in literature and therefore was not patentable. There is only one industry partner who has no commercial interest as such in the partnership and it is IP-G, the other partners all acknowledge patentability to be a potential action that they will take.

5.3.2.2 Commitment

The commitment of the project seems to be high among all the partners whom participated in interviews. These representatives talked with enthusiasm about the project and the need as well as the want to be an active part of the project. However, commitment is hard to measure at this point.

5.3.2.3 Resources and skills

The resources as well as the skills in the project are diverse. It is a huge difference between the partners where some of them are fairly small and cannot contribute with the same amount of personnel or have the same financial abilities as the large corporations. The main resources in which the research depends upon are the postgraduates, the university and the research institution. They are the workforce in the project lead by the senior supervisors. The interviewees are all positive towards their work but they also point out that the project is still in its early phases and if there was some expertise missing it is too early to tell. However, IP-E pondered over if there might be a possibility that any other institution of the university could contribute to the project with their knowledge and research. And IP-H mentioned a possibility of other universities, using the same type of speculations as IP-E. This speculation was something that the project manager did as well, however acknowledging that it is probably too costly to involve other academia.

5.3.3 Processes

5.3.3.1 Management skills

The manager of the project is highly valued as a great asset to the project. The manager is also the one managing the earlier mentioned parallel project and the structure of that project has been copied to this collaboration. When asking if the manager is a key person in the aspect of being invaluable however the answer was no with a reservation. The project would not fall without the manager but it would be serious for the time when rearranging the project. The manager has both skills in the field, previous experience and networking skills. The parallel project has at times changed manager, where the current manger is the third one, the parallel project has according to participants managed well in the change of manager and thus they believe a change, given the right circumstances, would not necessarily impact the project negative.

There is no formal boundary spanner in the project. But the manager together with the coordinator conduct tasks such as a boundary spanner does. They both are a link between the university and the industry.

5.3.3.2 Communication

The communication towards the industry partners are made with caution, so that it is not too frequent. Most of the communication is made at the project meetings held twice a year. Other communication is made by emails of important updates of the research. They furthermore share a map in "Box" which is a system for virtually and securely sharing documents over internet. At the project meeting it was suggested by the post-graduates that they could establish a database for their research so that everyone in the project could see their results which would help the post graduates to use each other's research as well.

5.3.3.3 Relationship and trust

Trust is said to be high between the partners and this seemed evident in the observation as well. All of the interview subjects mentioned long-term relationships to be a main factor why they collaborate with others. As IP-D mentioned it is not only the relationship to the other partners that is of interest but the potential relationships that the other partners can be a part in providing. When one need something they can ask in the established network if they know anyone and by that come into contact with others who otherwise would have been hard to reach. IP-H mentioned long-term relationships to be an important part when trying to innovate in a long-term setting. They divided innovations into two parts of short-term and long-term where this collaboration fell into the long-term perspective. Both the relationship as well as the trust has been developed between these particular organisations and persons during other collaborations, which evidently made the level of trust high already early on.

6. Analysis

The following chapter will outline an analysis of the case study in the lights of the theoretical research. Differences and similarities to the literature will be highlighted, and implications for the studied organisation will be given.

The collaboration which this study is based upon can be seen as open innovation in a closed framework. It is built around the need of openness in a situation where openness can be far to reach. It is interesting to see how similar this project is set up to the important factors in the literature, they adapted knowledge from other similar projects into their project, their efforts ended up in a similar position as the literature describes. The studied research project is coloured of previous experience. Therefore it is a well thought through organisation that has taken best practise from previous projects into a new one. Without studying the literature they have managed to follow many of the mentioned factors that are important for such establishments and even though organisations are unique it becomes evident that much attributes can be the same.

6.1 Contextual factors

The partners' openness is of immense importance since the project is built upon sharing of information. If information is not shared the project would basically be redundant. The companies within the project seem to understand the importance of sharing and they are therefore willing to share the information that they have. However there are companies that cannot share all information from their own organisation which is said not to have had any implications for the project at this point in time. The goal of those whom seem most likely to have additional information within their organisations seem willing to share as much as possible even from other projects if it could help this one forward. At the project meeting however there were some reluctance to share information when direct questions were asked, if this has to do with not enough knowledge at the time or other internal struggles is a question with no answer.

The university has a good reputation in itself and many of the industry partners mentioned the good quality of the research to be a factor why they were willing to become a part in the collaboration. The management board consist of five experienced researchers which is important, thus if one of them will change position and no longer be in the project it should not have too devastating consequences for the project since there are other experienced researcher as well as an university with a good reputation. Furthermore it was the university in itself and not the specific researchers that were mentioned in the interviews to have impact on the choice to collaborate within this project.

One potential threat to a successful collaboration is if a partnering organisation is restructuring their organisation. One of the partners within the collaboration is in the middle of a restructure. The literature suggest that organisations that do currently restructure or that

are likely to do so should not be asked to collaborate since this can have an effect on the partnership such as change of contact person or change in commitment. The partner with organisational changes will as it looks now continue to have the same representative from their company whom seem both committed and highly interested of the research project, thus it does not seem as it will have any profound impact on the collaboration at the moment. However an organisational restructure can always be surprising therefore when allowing new partners into the project it is important to look into their organisation holistically so that they have the best opportunities given for a successful collaboration.

Previous experience of this type of collaboration is vast among all the partners. Everyone has collaborated with someone in the group and everyone has had more than one previous collaboration cross-border. This has implications for the whole process since it might bring flexibility and understanding to the project. If a new partner should be invited to the collaboration that has no previous experience it is important to be clear on what is expected of this partner so that it will not disrupt the balance between the current partners.

The distance between the partners are not perceived among them as an issue which is supported by the literature with some reservations. The literature focuses on having face to face meetings on a regular basis and that the meetings will be the determinants of success not the distance. However at the project meeting three partners from the industry were unable to attend, all of them located at a distance of one and a half hour away by car or more. Even though this might not be the only factor it can be a contributing factor why they did not attend the meeting. Hence if they are unable due to a far distance it can have impact on the collaboration in the long-term point of view.

An interesting discussion is how success should be measured. Alexander et al (2012) points out that success is a subjective term opposite to performance. Within this collaboration the vision and objectives of the project correlates to the success of the same. Success is viewed different among the partners, however most of them have more than one objective with the project. The performance is one of the shared goals, to innovate and come up with a new material on the market, if the project manage to succeed with the production of a new type of material it would be seen as successful. However there is yet another common goal, which is to learn and to establish contacts. The learning can be all types of learning both how to conduct research and knowledge that can be transmitted but is not anticipated from the beginning. Thus if relationships and networks are enhanced and learning occur most of the partners would acknowledge the collaboration as successful.

6.2 Organisational factors

Even though it took six months for the formal agreement to be finished it is according to the literature not that long. The literature focus on trying to shortening down the negotiations of the contract since it is almost impossible to get a waterproofed contract that all partners are completely satisfied with. This agreement was based on an agreement from the parallel

project and due to this the time span could probably be shortened down in comparison with how long it could have taken to write a completely new agreement.

Commitment is mentioned in the literature as one of the most important factors for a successful collaboration. Commitment is however hard to measure. Those attending the project meeting and the interviewees seemed committed in how they talked about the project. However, there seem not to be any so called collaboration champions, one person with such commitment that the other partners can be inspired to become more committed. This is however an informal role which is hard to influence within an organisation. Nevertheless the manager of the team seems to be highly committed to it and goes the extra mile to fulfil the tasks at hand. The literature is unclear wetter the manager can have the effect of a collaboration champion, however the literature is clear on the fact that a committed leader is important in itself as this will influence the partners commitment to the project.

The project is well organised with different research groups that conduct research parallel and they furthermore have external financing. Factors that are important for the success of the collaboration. The researchers are skilled within their fields and the post-graduates as well, but speculations were made wetter they have enough expertise within the research group in total. Another institution of the university could have valuable input.

6.3 Process factors

The project manager has extensive experienced of this type of setting and is valued among the partners. The management of the collaboration is compiled of the university together with the research institute, which most partners think is the best setting as they believe it becomes more objective if it is handled by the university that has no commercial interest of the innovation. However, some authors argue that the best case would be to have a shared management between university and industry.

A formal boundary spanner does not exist in the project. However, it might not be a need for a formal boundary spanner. Perutze et al (2010) suggest that there is no need to choose one person to be a boundary spanner as long as the function of a boundary spanner is present. Within this collaboration the manager and the coordinator of the project becomes boundary spanners since both possesses knowledge of the field and they have extensive contact with the industry partners as well. The function of a boundary spanner becomes more efficient with visits to companies which is something that will happen since both IP-A and IP-H is planned to be visited soon. This is however something that need to be done continuously, the boundary spanner function will only be functioning if it is an ongoing process to be an active link between the industry and university.

Communication is important within this collaboration since it is the university that conduct the research and the industry partners are more a type of stakeholders in the process. The

industry partners give input at occasions when they meet but they do not conduct any research themselves, therefore it is important that the process and progress is communicated to the partners so that they get update on the work. Too much communication can be a problem, but this collaboration tries to keep the direct communication to a minim so the partners should not lose interest due to too much information. The system of a virtual platform for sharing documents which individuals can visit when they want is a smart tool for the openness.

One of the most important factors for a collaboration mentioned in the literature is the relationship and trust. When innovating in a long term setting it is important to build trust among the collaborators as well as a long term relationship. This is evident within this collaboration that relationship and trust is high and that this has had implications for the collaboration. Everyone has collaborated with someone in the group before and the companies who were asked and said no had no previous relationship with the partners in the group. Thus the long-term relationship is a factor for the future collaboration and it was apparently one important reason why the group look like it does today.

6.4 Innovation

The linear view of the innovation process is seen as outdated of many authors. The consensus has started to line up behind the notion that innovation can never be conducted in a linear fashion from A to B. And still there are a profound amount of literature in the field that give the one size fits all answer in their analysis. Organisations are unique and different organisations have different needs. The innovation process needs to be more iterative, where the different parts of the process should always be apparent. The linear process suggest that the market is only thought of at the end of the innovation, but the iterative view claims that the market has to be thought of from the beginning and onwards where iteration is made during the process. There are always considerations made of where to commercialise the product and who the customer can be, which during the process can be changed due to new ideas and new characteristics of the product.

Innovation theory suggests that the innovation process should consider the market and be open in the early phases so the innovation process is not closed in on one issue too early. This project is in the early phases of R&D and thus it is hard to consider the market, however the industry partners representing potential end-users help the organisation to recognise potential end-user attributes. Furthermore the project has taken the two opposite parts in the research with the opposite attributes, thus they look into attributes from a wide spectrum that will be beneficial for many outcomes. They have thus thought of the market already in this early phase. However, it is important to continue with the thought of how to implement the innovation and what attributes will be beneficial in the future. Even scalability is important in an early phase so consideration is taken to how the material should be produced outside a laboratory.

7. Concluding remarks

The aim of the thesis was to investigate the complex relationship between university and industry collaboration in an R&D setting, and to find success factors in such a process, to apply on an already established collaboration. Therefore theory concerning this type of organisations was researched and analysed in combination with the studied project in order to answer the research questions.

- What factors are important for a successful R&D collaboration between university and industry actors?
- What factors are already included in the case projects innovation process?
- What implications can this have on the case project?

Important factors for successful university-industry R&D collaboration

It becomes apparent that the collaborative factors are the most important factors in an innovation process with university-industry collaboration. It is the uniqueness of the group that sets the agenda of the project and the project can be conducted with a process that fits the given research agenda. The literature provides ample of important factors that are seen as success factors for this type of collaboration, however the most important factor seem to be related to the partners in whom to choose as well as how to build relationships. A long-term relationship with high trust is a key success factor for this type of venture since it will enhance the chances to overcome barriers which can be immense between organisations as different as universities and commercial businesses. Relationships influence both the validation of whom to collaborate with as well as the process of collaboration. It will influence the roles within the organisations as well as the tone for discussions that need to be both friendly and open minded. The relationship influences the whole collaboration and is a key in most of the success factors, a good relationship is the foundation for a successful collaboration.

Factors that are already included in the project

It becomes evident that the research project is structured in a well-established manner. Previous experience has become the guidance for the collaborating partners and their internal routines. The parallel projects in which many of the partners already collaborate within are used as a blueprint of how to set up the collaboration in this study and structures has been copied from this parallel project. Wetter the project will be successful or not depends on the notion success. Will success be to reach the pre-set goal of finding a new material in the project or is success the knowledge transitions? The answer is given in the objectives of the partners. Commercial interest and academia struggle together towards the same goal of new knowledge.

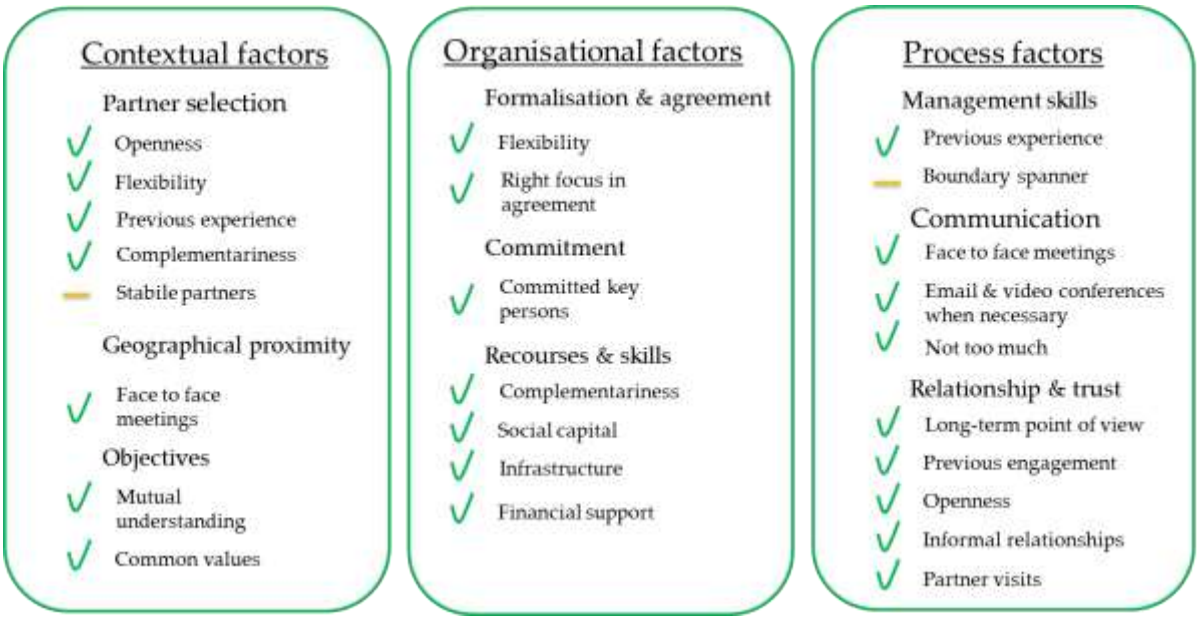

Figure 14. Factors included in the collaboration

The collaboration includes almost all of the mentioned success factors. One of their partners has a somewhat unstable organisation, but that partner was selected due to previous engagement and long-term relationship hence still in line with success factors. There is no formal boundary spanner in the project, but it seems that there is some sort of boundary spanner function in the management team.

Implications

The collaboration is a balancing act between formal and informal, open and closed, university and industry. There need to be a balance to ensure that the collaboration is both smooth as well as for the innovation process to end up in an innovation. Innovation and people need nurturing. If it functions well at one point in time it does not mean it will always function. It is important to continue with activities that can bring the innovation forward. The collaboration seems to be fairly balanced at this point however with informal ties becoming more and more developed. Thus it is important to continuously use the formal ties so that the informal does not take over, and vice versa.

The organisations should reassess and evaluate the in-house expertise continuously, lack in knowledge and expertise can make the project prolonged. Continually evaluate if there is a lack of expertise or input from industry sector. Reflect upon if there is a need of a completely new partner as well, to get new input from a new source. But foremost continue to build on relationships with a long term point of view.

The end-user value need to be taken into consideration in every stage of the innovation process and the early phases of R&D is no exception. Thus use the established network and assess ideas and information continuously, where risks of procedures should be identified in order to become flexible in the process.

Openness and trust were ideas are considered with an open mind and everyone can ask questions need to be sustained. The diversity of the collaboration is an asset which will bring questions at the individual level that are obvious to some, those questions are however important to bring forward and answer with no judgement. Try to enhance knowledge exchange of different types of knowledge so both tacit and explicit knowledge can be transferred within the group, and be both flexible and understanding towards different objectives among the partners so the different values will be aligned towards one mutual goal.

Conclusion

Organisations are unique and there is no "one size fits all" approach in organisational theory. However there are common factors that can be applicable on similar organisations and the success factors within this study are somewhat general so that they can be tweaked into the specific organisation. The studied organisation of this thesis does exactly this where they have tweaked the factors to fit their organisation. Thus the case study confirms the literature of university-industry collaborations in R&D and can therefore function as a raw model for how to work within a collaboration of this sort.

"Learning without thinking is useless. Thinking without learning is dangerous."
– Confucius 551 BC

8. Limitations and future research

This research has provided an overview of success factors within university-industry collaborations. The limited timeframe of the thesis has been a factor to why the research could not be more comprehensive. Further research of the success factors would therefore be of interest, for a deeper understanding and to see the real processes behind. Studies could focuses on one of the three main areas to give hands-on recommendations for these types of organisations.

Furthermore, this study is a single case study and has focused upon one case that confirms the literature in the field. One case is however not enough for validation and therefore multiple case studies need to be conducted in order to give a real view of the field. It would additionally be of interest to study organisations that have failed with their objectives in order to see what caused the failure and compare that with the success factors within this study to see if they correlate. If only surviving and successful organisations are represented there will be a survivor biased represented and factors that are threats to success might be concealed from the researcher.

Appendix

Interview guideline

Roles

- What role in the project do you have? Your company?
- Describe your role in the project.
- What is the role of the leader? Administrative etc?
- Which roles do representatives from the company and university have?
- How does the leader communicate with the partners?
- Is there any informal leaders?
- Does everyone have the same saying in the project?
- Have there been any conflicts during the project?

Organisation

- How is the project organised/structured? Research team (team size, people involved)?
- How often do you meet in the team?
- How is decisions made? How, when, where etc
- Do you have enough time for the project?
- How is the work impacted of being a collaboration between industry and university?
- Does everyone contribute the same?
- How do you feel about openness in the project? Does anyone have any barriers in their organisation that prevent them from sharing information?

Processer

- Describe how the work process is structured and how you work.
- Are there regular reviews of the project process?
- Are progress reports made available at the project level on a regular basis?
- How do you communicate? How, who, when, where etc
- How many projects is one person handling? How much time is dedicated to the collaborative project?

Innovation

- What is your perception of innovation?
- How to you look upon the product that can come from this project? (Impact vice)
- Have someone filed for a patent?
- How is new ideas handled and implemented? How does the organisation take in new ideas?
- What will happen after 2018?
- Is there a discrepancy between knowledge and participation?
- Is there a lack in knowledge in the project?
- What knowledge do you contribute with?
- What motivates you/your organisation in the project?

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