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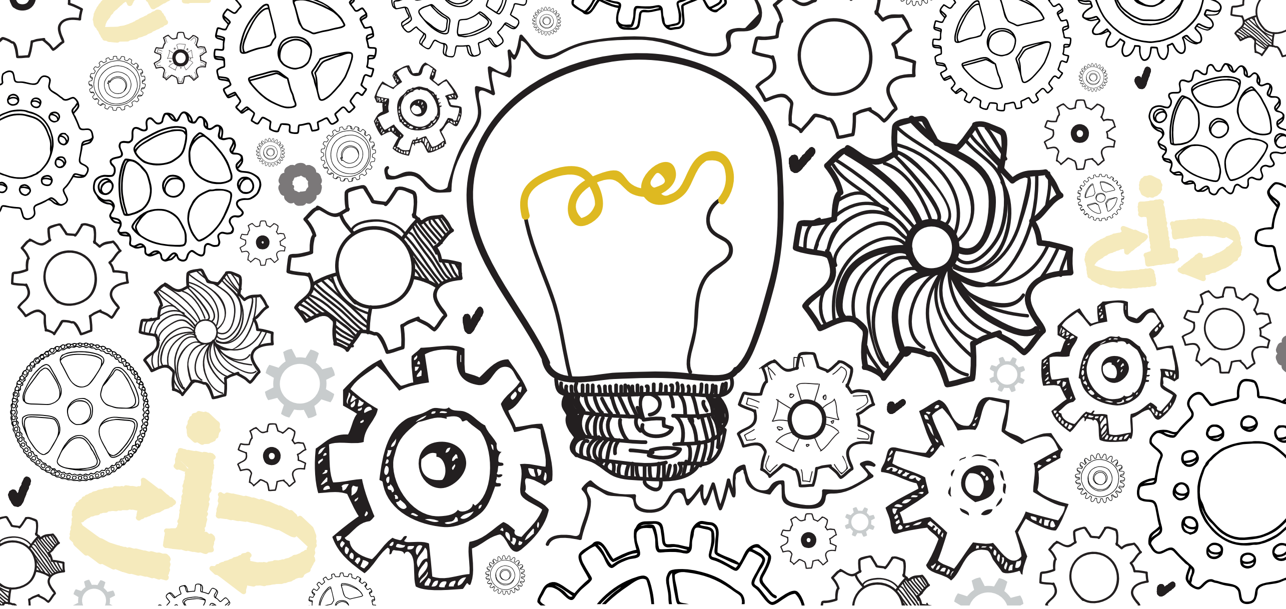

DISSEMINATING SCIENTIFIC KNOWLEDGE TO SMALL AND MEDIUM-SIZED ENTERPRISES

BY
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AALBORG UNIVERSITY
DENMARK

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In memory of my fantastic grandfather

who did not get to see me finish this work

but who was always inspiring and supporting me

ENGLISH SUMMARY

In this thesis, I examine, develop and evaluate the dissemination of scientific knowledge between university and industry, specifically small and medium-sized enterprises (SMEs). The motivation for the research originates in the Danish science-society debate, which has increased over recent decades. While the traditional missions of universities are research and teaching, there has been a growing attention on the 'third mission', which covers universities' responsibility to stimulate a greater awareness and exploitation of scientific knowledge outside academia. However, while getting scientific knowledge from universities to the outside world is commonly considered profitable, finding successful ways of how to do it remains a challenge. The thesis provides new perspectives on this matter.

Through a number of mainly explorative studies, the thesis examines, develops and evaluates how scientific knowledge can be disseminated to SMEs. The thesis explores the dissemination of existing scientific knowledge in the form of Pure data from VBN (Knowledge Base of Northern Jutland), which is the Research Information Management System of Aalborg University. Using existing scientific knowledge from VBN as a case requires scientific knowledge to be explicit, encoded and demonstrative. For this reason, the thesis focusses on the dissemination of scientific knowledge through generic pathways (e.g. published research, patents, research facilities, employed new graduates).

Understanding SMEs' preferences for the dissemination process is a central part of the thesis' contribution. The conditions of SMEs differ significantly from those of larger enterprises, for example because they have fewer employees and limited financial resources for in-house research and development. Because of this, SMEs can be said to have a greater need to access external knowledge. Working with a variety of SMEs to create mainly qualitative data, the thesis seeks to understand SMEs' conditions and preferences related to (scientific) knowledge. The thesis further focusses on understanding what is required in order for SMEs to find scientific knowledge accessible, understandable, relevant and usable. These understandings form the basis for developing and evaluating an actual generic pathway that makes possible a concrete exploration of how existing scientific knowledge can be disseminated to SMEs.

By that, the thesis not only examines how scientific knowledge is disseminated at present; it also explores how it can be done in the future. The contributions of the thesis include:

- A Literature Study that analyses and categorises the known barriers and solutions to dissemination of scientific knowledge to enterprises in general and SMEs in particular.
- An analysis of SMEs' situation related to (scientific) knowledge, which provides new and nuanced insights about the perspectives of SMEs and their preferences regarding external knowledge acquisition.
- The creation of communicative principles for the optimised dissemination of scientific knowledge to SMEs.
- An analysis of the characteristics and organisation of the specific type of scientific knowledge that exists in VBN.
- A development process that exemplifies and concretises how scientific knowledge can actually be disseminated to SMEs through generic pathways.

In total, the research conducted in this thesis strengthens the common knowledge on the field and contributes with several new and nuanced insights on the subject. By focussing particularly on (1) SMEs, (2) existing (explicit and encoded) scientific knowledge and (3) generic pathways, the thesis takes a unique standpoint and separates itself from existing research on 'the dissemination of scientific knowledge'.

DANSK RESUME

I denne ph.d.-afhandling undersøger, udvikler og evaluerer jeg formidlingen af forskningsbaseret viden mellem universitet og erhvervsliv, særligt små- og mellemstore virksomheder (SMV'er). Afhandlingens fokus relaterer sig til den danske forskningsformidlingsdebat, som er taget til i de seneste årtier. Traditionelt set består universiteternes primære opgaver i at bedrive forskning og undervisning, men der kommer i stigende grad fokus på 'det tredje ben', som dækker over, at universiteterne nu har et ansvar for at levere viden, der kan anvendes og skabe værdi i det omgivende samfund, og at de er forpligtede til at dele denne viden med alle interessenter. Formidling af forskningsbaseret viden anskues som særdeles udbytterigt for samfundet, men der er fortsat mangel på metoder og konkrete anvisninger til, hvordan denne formidling faktisk kan (og bør) finde sted. Denne ph.d.-afhandling bidrager med nye perspektiver på og inden for dette felt.

Gennem en række primært eksplorative studier udforsker afhandlingen, *hvordan* forskningsbaseret viden kan formidles til SMV'er. Afhandlingen fokuserer på formidling af *eksisterende* forskningsbaseret viden, hvormed der henvises til den type af viden (Pure data), der forefindes i VBN (Vidensbase Nordjylland), som er Aalborg Universitets online-forskningsportal. Denne type af viden kan karakteriseres som eksplicit og kodet, hvilket sætter nogle rammer for, hvilken type formidling denne afhandling adresserer (undersøger, udvikler og evaluerer). Det er således formidling af forskningsbaseret viden gennem *generiske kanaler* (for eksempel publiceret forskning, patenter, forskningsinstitutioner eller ansættelse af nyuddannede), der fokuseres på i afhandlingen.

En central del af afhandlingens bidrag er, at den skaber forståelse for SMV'ernes situation og præferencer i forbindelse med (forskningsbaseret) viden. SMV'ernes vilkår er markant anderledes end større virksomheder. De har for eksempel færre ansatte og begrænsede finansielle ressourcer til intern forskning og udvikling. Det kan derfor hævdes, at SMV'er har et større behov for at tilegne sig viden eksternt. Ved inddragelse af en række forskelligartede SMV'er og generering af primært kvalitative data søger afhandlingen at afdække SMV'ers vilkår og præferencer i relation til (forskningsbaseret) viden. Den fokuserer desuden på at forstå, hvad der kræves, for at SMV'er finder forskningsbaseret viden *tilgængeligt*, *forståeligt*, *relevant* og *brugbart*. Disse forståelser danner udgangspunktet for at udvikle og evaluere et nyt webinterface (en generisk kanal), hvilket muliggør en konkret udforskning af, hvordan forskningsbaseret viden kan formidles til SMV'er.

Dermed undersøger afhandlingen ikke blot, hvordan forskningsbaseret viden formidles for nuværende. Den udforsker også, hvordan det kan gøres fremover. Afhandlingens bidrag består af:

- Et litteraturstudie, som analyserer og kategoriserer de velkendte barrierer og løsninger relateret til formidling af forskningsbaseret viden, både målrettet virksomheder generelt og SMV'er specifikt.
- En analyse af SMV'ers situation relateret til (forskningsbaseret) viden. Dette tilvejebringer nye og nuancerede forståelser af SMV'ers perspektiver på og præferencer i forhold til ekstern videnstilegnelse.
- Udformningen af kommunikationsprincipper for den optimerede formidling af forskningsbaseret viden målrettet SMV'er.
- En analyse af den specifikke type af viden (karakteristika og organisering), der eksisterer i VBN.
- En udviklingsproces, der eksemplificerer og konkretiserer, hvordan forskningsbaseret viden kan formidles til SMV'er gennem generiske kanaler i praksis.

Sammenlagt styrker afhandlingen fælles viden på området, og den bidrager med nye og nuancerede forståelser. Ved at fokusere særligt på (1) SMV'er, (2) eksisterende (eksplicit og kodet) forskningsbaseret viden og (3) generiske kanaler har afhandlingen et unikt udgangspunkt, og den adskiller sig fra eksisterende forskning om formidling af forskningsbaseret viden.

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CHAPTER 1: INTRODUCTION

The aim of this thesis is to examine, develop and evaluate the dissemination of scientific knowledge between university and industry, specifically small and medium-sized enterprises (SMEs). The PhD project was launched in 2012 as a collaboration between the e-Learning Lab at the Institute of Communication and Psychology at Aalborg University and the VBN (Knowledge Base of Northern Jutland) Editorial Office at Aalborg University Library. The objective was to optimise the dissemination of existing scientific knowledge to SMEs, using North Jutland SMEs as cases. Here, 'existing scientific knowledge' refers to the knowledge that exists in the VBN database. As I will elaborate on shortly, this is a specific type of knowledge that is characterised by being explicit (Polanyi, 1966) and encoded (Blackler, 1995) (versus tacit and embodied), which sets some boundaries for the type of knowledge dissemination that will be addressed within this thesis. As a consequence, the thesis explores how (1) existing scientific knowledge can be (2) disseminated to (3) SMEs through (4) generic pathways. While all of these factors will be elaborated on throughout this chapter, I will begin by motivating and contextualising the thesis and its research aim.

1.1 MOTIVATION

The motivation for the research originates in the Danish science-society debate, which has increased over recent decades. Knowledge has become a key resource in the modern economy (Hague, 1991) and, accordingly, dissemination of scientific knowledge is a relevant topic for Danish universities. We talk about 'the knowledge economy' (Powell & Snellman, 2004) and 'the information society' (Raban, Gordon, & Geifman, 2011), where knowledge is rapidly exchanged and developed. Common understandings are that knowledge has become more important, that the number and significance of knowledge-intensive organisations has increased and that the knowledge-intensity in organisations and work in general has increased in the modern economy (Alvesson, 1993). These circumstances affect the production and use of scientific knowledge. The demand for scientific knowledge grows, and, consequently, scientific knowledge has become a societal affair (The Ministry of Science, 2004). However, while disseminating scientific knowledge from universities to the outside world is commonly considered profitable, it is also challenging. There are many reasons for this and they will be unfolded thoroughly during the thesis. For now, it is sufficient to mention that part of the problem is that the efforts to ensure that scientific knowledge reaches the most appropriate audience, in the most appropriate form, and in a timely manner, are largely absent (Hague, 1991). While this was stated by Hague more than 25 years ago, it has been repeated many times since and is still the case. Accordingly, new efforts to disseminate scientific knowledge from universities to the outside world must be made, of which this thesis is an example.

Over the past decades, a lot has been written about knowledge dissemination between science and society. The university as an institution is often labelled an 'ivory tower', which is an expression dating back to the 19th century, where it was used about philosophers and writers (Kjærgaard, 2006). The term suggests an unwillingness and incapability to reach the outside world. In this perspective, researchers are portrayed as withdrawn and isolated, not concerned about the world around them. It relates to the fact that the traditional missions of universities are research and teaching, where universities are primarily expected to (1) deliver well-educated graduates and thereby provide society with excellent human resources, and (2) to engage in basic research that can be applied and developed in various technical categories and thereby foster economic growth (Fukugawa, 2013). However, with the rise of the knowledge economy, there has been a growing attention on universities' 'third mission', which covers their responsibility to stimulate a greater awareness and utilisation of scientific knowledge outside academia. This includes commercial activities such as patenting, licensing and company formation (Baycan & Stough, 2013). Accordingly, the university is increasingly seen as a source of new ideas, inventions and regional/national innovation and is expected to support and generate economic growth by the production of new knowledge, human capital, licensing innovations and the creation of new enterprises. These developments have led to the emergence of phenomena such as 'entrepreneurial universities' (Etzkowitz, Webster, Gebhardt, & Terra, 2000) and 'academic entrepreneurship' (Meyer, 2003). According to Muscio and Pozzali (2013), universities are generally more committed to embracing their third mission than in the past. However, although the scientific world is increasingly willing to look outwards, finding successful ways of how to do it remains a challenge. Too often it is up to non-scholars to spontaneously search for scientific knowledge, which they rarely do (Kjærgaard, 2006). To non-scholars, the scientific world can be a large, impervious unit of knowledge which is hard to comprehend, and to them, the university might very well continue to appear as an ivory tower. This may well be the case for SMEs in particular. As I will address in-depth in Chapter 4, universities and SMEs have different expectations, interests, motives or reasons for engaging in knowledge dissemination (Muscio & Vallanti, 2014; Siegel, Waldman, Atwater, & Link, 2003). According to Bruneel, D'Este and Salter (2010, p. 859), "academics wish to create 'leaky' knowledge so that their ideas can be acknowledged by their peers while firms need the knowledge to be 'sticky' and thereby not available to their competitors". Finding out how to overcome these differences in order to ensure a successful dissemination of scientific knowledge is a central focus of the thesis.

1.2 THE INTERNATIONAL PERSPECTIVE

For more than 30 years, the United States and European countries have attempted to develop 'the right' infrastructural support to ease knowledge dissemination between universities and businesses. According to Geuna and Muscio (2009), these attempts have resulted in some success, but mostly failure, bearing witness to the difficulties inherent in the development of a successful organisational set-up for the dissemination of scientific knowledge from university to business and society. Academic entrepreneurship has been a unique characteristic of the U.S. higher education system for the past 100 years (Mowery, 2005). Furthermore, U.S. universities have long been communicating scientific results as a promotional parameter for attracting new students and financial support. This long history of interaction and academic patenting and licensing contributed to the formation of the political coalitions that led to the passage of the Bayh-Dole Act in 1980. The Bayh-Dole Act created a uniform patent policy among the many federal agencies that fund research, and allowed universities and other federal contractors to retain title to inventions made under federally-funded research programs. In the wake of the Bayh-Dole Act, the focus on commercialisation of knowledge in the U.S. heightened and, accordingly, U.S. universities increased their efforts in technology transfer, licensing and investments in new enterprises (Baycan & Stough, 2013).

The changes in American universities in the 1980s initiated European attention to the science-society dialogue, which was kick-started by the Bodmer Report (Bodmer, 1985). The Bodmer report emphasised the importance of public understanding of science and concluded that an understanding of science is important to individual citizens, workers and decision-makers. It makes several recommendations on how to improve public understanding of science, including stating that researchers must learn to communicate better with all segments of the public, and that it is clearly a part of each researcher's professional responsibility to promote the public understanding of science.

In Europe, the practices around scientific communication are still a major issue (Claessens, 2008, 2012; Geuna & Muscio, 2009). European universities, aspiring to develop strong knowledge economies and enhance economic growth, are powerful sources of innovation and providers of strong ideas and human capital to business and society (Agrawal, 2001; Ambos, Mäkelä, Birkinshaw, & D'Este, 2008; Ankrah, Burgess, Grimshaw, & Shaw, 2013; Etzkowitz, 1990). In the Lisbon strategy from 2000, the European Union set itself a new strategic goal for the next decade: "To become the most competitive and dynamic knowledge-based economy in the world, capable of sustainable economic growth with more and better jobs and greater social cohesion" (European Council, 2000). Furthermore, a goal was to invest 3% of the EU's gross domestic product (GDP) in research and development (R&D). Ten years later, evaluating the strategy led to the conclusion that while the strategy has had a positive impact on the EU, the goal regarding R&D investment was not reached (European Commission, 2010). The goal to invest 3% of the EU's GDP in R&D reappears in the Europe 2020 strategy. In conclusion, knowledge dissemination continues to be a focus point and it has become a strategic issue, not only for universities but also for decision-makers (Geuna & Muscio, 2009). However, despite a growing number of public communications about science activities in Europe, and increasing support from public authorities, there is still a gap between science and society (Claessens, 2012).

1.3 THE DANISH CONTEXT

In 2003, the Danish University Law was introduced, which essentially kickstarted the Danish science-society debate. The University Law states that universities are obliged to collaborate with the surrounding society, contribute to the development of international collaborations, contribute to the enhancement of growth, welfare, and development in society, and exchange knowledge and competencies with society (Ministry of Higher Education and Science, 2003). In other words, Danish universities were now obliged by law to share their knowledge with business and society. By giving priority to the dissemination of science, the goal of this law was not only to increase the Danish population's knowledge of science, but also to engage Danish universities in the global race to become strong knowledge economies (Horst, 2012).

Since the first scientific journal was released in Denmark in 1673, Danish researchers have systematically disseminated their research to the public (Burchardt, 2007). By that, the primary consequence of the Danish University Law of 2003 was that this dissemination became a governmental demand rather than a voluntarily scientific activity. Accordingly, Danish universities have had to systematise their dissemination of information and upgrade their documentation. As outlined by Horst (2012), the Danish University Law of 2003 changed the societal role of Danish universities, moving from a generalised perception of universities as societal institutions to universities as individual organisations competing for public research funds, value-added grants, and the attention and respect of the public. Thus, universities are increasingly becoming distinguished brands, and consequently dissemination of scientific knowledge has become a tool to ensure market value. This leads to a professionalisation of communication.

In the aftermath of the University Law, a number of governmental activities formed the Danish practices on knowledge dissemination between universities and the business sector:

- In 2003, the Danish Minister of Science formed a think tank concerning the understanding of scientific knowledge. In 2004, the think tank published a report with recommendations for the future communication of science (The Ministry of Science, 2004). Their recommendations regarded the public at large and brought attention to the need for universities to prioritise communicating science (rather than only conducting it). Among others, they mentioned creating incentives for researchers to engage in communicational activities, developing a strategy for the communication of science, using two percent of all scientific funds for communication, and incorporating the communication of science into the education of researchers.
- In 2003, the Danish Government launched an Action Plan called New Roads between Science and Business (Regeringen, 2003). This charted a course for the commercialisation of scientific knowledge in order to improve the innovation and economic growth in Denmark. They stated that Denmark was not good enough at disseminating scientific knowledge to the business sector, and vice versa: The experience and knowledge of the business society had to be better reflected in science and education. In other words, science had to 'give something' back to society. This increased the political and public attention of the use and value of scientific knowledge.
- In 2012, the Danish Government launched an Innovation Strategy dealing with the innovativeness of Danish enterprises. They concluded that the Danish investments in knowledge and education were not sufficiently converted into growth and jobs in Danish enterprises. Mutual exchange of knowledge between educational institutions and enterprises was prioritised in order to increase the Danish innovation capacity. The Innovation Strategy proved a continued political focus on improving the commercial potential of scientific knowledge.
- In 2013, a report by DEA analysed the efforts of knowledge dissemination by the Danish universities since 2003 (DEA, 2013). While the analysis showed that a significant and positive development on knowledge dissemination from Danish universities had happened, it also pointed out that, at large, the Danish universities had not succeeded in creating a direct and documentable economic profit. It stated that

much of the legislation made to improve the dissemination of knowledge instead inhibited it. A very important result of this work was that scientific knowledge was considered a product that requires a significant amount of translation in order to be 'sold' to the outside world. The reason being that there is a large gap between scientific validation and the validation necessary for private investors to make a qualified assessment of the commercial potential. The report stated that the political agenda had not accounted for the extent of this fact. For the same reason, the report concluded that knowledge dissemination usually requires an ongoing collaboration between researchers and business representatives in order to be successful.

- In 2015, the Governmental Plan for Growth (The Danish Government, 2015) highlighted a need to fortify the interplay between higher educational institutions and enterprises. It further mentioned that relevant knowledge from universities must be of benefit to the growth and development of enterprises, and furthermore that collaboration between educational and research institutions and SMEs, especially in smaller cities, must be strengthened.

As stressed by Hague (1991), in the knowledge society, knowledge will be a widely-traded commodity. The successful university will in part succeed by competing effectively in that trade, as professionals, not amateurs. As the above-mentioned initiatives illustrate, Danish dissemination of scientific knowledge has increasingly entered the political agenda for the past 15 years. It bears witness to a demand for dissemination of scientific knowledge to become still more professional and goal-oriented.

1.3.1 EXEMPLIFYING DANISH KNOWLEDGE DISSEMINATION

Seeing as the thesis is primarily written in a Danish context, I will give some examples to illustrate the current Danish scene within knowledge dissemination. First, the most popular nationwide initiatives that have managed to create positive awareness about scientific knowledge:

- Forskningens Døgn (The Danish Science Festival)
  Organised by The Danish Ministry of Higher Education and Science, the purpose of the festival is to establish a meeting place for researchers and the general public and thereby support public engagement in research. Every year, the festival hosts about 600 events in more than 100 cities and is visited by more than 75,000 guests (Sekretariatet for Forskningens Døgn & Styrelsen for Forskning og Uddannelse, n.d.).
- Ph.d. Cup (PhD Cup)
  Started in 2013 and organised by Dagbladet Information, DR and Lundbeckfonden, PhD Cup is an annual dissemination contest,

broadcast on national television, where PhD students compete to communicate their research to society at large (Ph.d. Cup, n.d.).

- Videnskab.dk (science.dk)
  The popular website delivers scientific news to society at large on a daily basis. The aim is to enhance the knowledge of the public and arouse an interest in science (Videnskab.dk, n.d.).
- Tænkepause (Reflections)
  Since 2012, Aarhus University has published the very popular book series with the slogan '60 pages, 60 minutes'. The idea is to give the public a condensed access to scientific knowledge, written without 'academic nonsense' (Aarhus Universitetsforlag, n.d.).
- Bloom, the Golden Days Festival
  An open-air festival celebrating nature and science. Here, researchers, philosophers and artists talk about nature and the universe to a public audience. At the Golden Days Festival, scientific knowledge is honoured and 'science is allowed to talk the language of science' (Golden Days Sekretariat, n.d.).

Besides these large initiatives, a range of smaller ones are worth mentioning. In 2009, a collaboration between the Danish Broadcasting Cooperation and the higher knowledge organisations resulted in the broadcasting of lectures on national TV called Danskernes Akademi (Academy of the Danes). It ended after four years and more than 1000 broadcasts. Scientific fight nights, so-called science-slams, (Science slam, Aalborg University, n.d.) and public lectures in social settings, i.e. Kort Sagt (Kort Sagt, n.d.) or Vin og Videnskab (Statens Naturhistoriske Museum, n.d.) make room for scientific knowledge to be a social and entertaining public activity and are very popular. Examples of displaying artistic science communication installations (see for example Horst & Michael, 2011) in public places such as malls and libraries can also be found. Collectively, these initiatives bear witness to a focus on disseminating scientific knowledge to society at large and, furthermore, that a public interest in scientific knowledge exists.

According to The Ministry of Science (2004, p. 9), four types of scientific communication exist:

1. Researchers communicating with other researchers
2. Researchers communicating with students
3. Researchers and higher education institutions communicating with the business sector
4. Researchers communicating with different groups in society at large

The above-mentioned examples illustrate that the main focus of the professionalised Danish dissemination of scientific knowledge is addressed at society at large. Dissemination activities specifically targeted at the business sector are largely absent.

1.4 SMALL AND MEDIUM-SIZED ENTERPRISES

This thesis focusses on the dissemination of scientific knowledge to small and medium-sized enterprises (SMEs). The SME definition covers the category of micro, small and medium-sized enterprises and is made up of enterprises employing fewer than 250 persons and with an annual turnover not exceeding EUR 50 million (European Commission, 2015).

Company Category	Employees	Turnover	Balance Sheet Total
Micro	<10	<€2 million	<€2 million
Small	<50	<€10 million	<€10 million
Medium	<250	<€50 million	<€43 million

Table 1.1. SME categories. Source: (Muller, Devnani, Julius, Gagliardi, & Marzocchi, 2016, p. 3)

SMEs deserve attention since they account for a substantial part of the European Union's economy. Nine out of every ten enterprises in the EU are SMEs (European Commission, 2015). In 2015, just under 23 million SMEs generated €3.9 trillion in value and employed 90 million people, which accounts for two thirds of EU28 employment (Muller et al., 2016). The vast majority of SMEs are micro enterprises with fewer than 10 employees. Such very small enterprises account for almost 93 percent of all enterprises in the non–financial business sector (Muller et al., 2016).

In Denmark, the business structure is characterised by many micro enterprises with fewer than ten full time employees (Danmarks Statistik, 2017). Approximately 289.000 workplaces exist, and the majority of these are small. At two thirds of them less than five jobs exist, and only a little less than 10.000 Danish work places have 50 or more jobs. Hence, in a Danish context, an enterprise with 100 employees is considered a large enterprise. Numbers from the Central Business Register show that there are 31.065 enterprises with a maximum of 250 employees in the Region of Northern Jutland alone. The large number of Danish SMEs plays an important role in the Danish business landscape, and for this reason they are a relevant target group for this research.

The conditions of SMEs differentiate significantly from those of larger enterprises. These conditions are important to understand in order to grasp why new ways of disseminating scientific knowledge to SMEs need to be explored. Enterprises investing in research and development are on average nine percent more productive than enterprises that do not (Forsknings- og Innovationsstyrelsen, 2010). Due to the smaller scale in which SMEs operate, they generally have fewer employees and limited financial resources for in-house research and development. Gassmann, Enkel and Chesbrough (2010) address the acknowledged understanding of SMEs having a 'liability of smallness', which refers to them being small and generally lacking resources. SMEs can overcome this liability, they say, by opening up the innovation process. This means accessing and utilising external resources (de Zubielqui, Jones, & Lester, 2016). According to Audretsch, Lehmann and Warning (2004), enterprises access external knowledge at a cost that is lower than the cost of producing this value internally. Consequently, SMEs have a greater need to access external knowledge.

A relevant understanding of SMEs' situation is expressed by Ranga, Miedema and Jorna (2008), who cite Woolgar, Vaux, Gomes, Ezingeard and Grieve (1998) when defining the *SME-centric universe*. In this approach, SMEs are at the centre of their own world, not isolated, but relating most intensively with their suppliers and customers. Universities fall well outside SMEs' focus because SMEs have very specific and specialised concerns, to which the notion of research is largely remote. Because of this, communication between universities and SMEs often fails to happen. Similar to this, de Zubielqui, Jones, Seet and Lindsay (2015) found that SMEs tend to form expressive ties with organisations and people within their supply or value chains. Such organisations are primarily customers and suppliers. SMEs, consequently, overlook universities when appropriating information and new knowledge.

SMEs possess a large economic potential because of the flexibility of this type of enterprise. Thus, the innovativeness of Danish SMEs is a crucial factor in the global competition. Their often short-termed focus and lack of resources are potentially blocking innovation. Despite a lot of good business ideas, a substantial number of Danish SMEs does not have the resources to complete the necessary development (Forsknings- og Innovationsstyrelsen, 2009). In the race to become a strong knowledge economy, enabling Danish SMEs to acquire scientific knowledge can benefit not only universities and individual SMEs but also society at large.

1.4.1 DANISH UNIVERSITIES REACHING OUT TO SMEs

At Aalborg University, increased attention is paid to interacting with SMEs. The 2016-2021 strategy for the Institute of Communication and Psychology states that the activities on scientific knowledge must be prioritised (Institut for Kommunikation og Psykologi, Aalborg Universitet, 2016), and the overall strategy for Aalborg University, *Knowledge to the World*, states that "AAU must acknowledge its embeddedness in a society dominated by small and medium-sized companies; these do not have the same strong tradition of cooperating with the University. We must therefore direct a special focus on cooperating with small and medium-sized companies, thus contributing to increasing their capacity for innovation" (Aalborg University, 2016, p. 24).

According to Burchardt (2007), all Danish universities have rearmed their communication fronts. Danish universities are very concerned with the importance of good relations with SMEs, and according to a report by Danish Universities, they generally do a good job reaching SMEs (Danske Universiteter, 2014). I would argue that two reservations should be added to this conclusion. First, all Danish universities are very aware of the need to communicate with SMEs, but this does not necessarily mean that SMEs experience it as successful. To explain, most of the Danish universities' websites include a tab called something like 'Collaboration' or 'Business collaboration'. These subpages include information about what collaborative activities are available, for example to SMEs. However, this requires SMEs to spontaneously and through their own initiative look for scientific knowledge. Second, it is worth noticing that the communication between Danish universities and SMEs is mostly confined to creating collaborations acquiring interpersonal contact between enterprises and researchers/students. To exemplify, the following initiatives have been launched by the universities:

- Aalborg University: Matchmaking. Matchmakers facilitate a number of collaboration possibilities, including student collaboration, networking, laboratory facilities and collaborations on developing scientific knowledge. Matchmaking is aimed at SMEs and larger enterprises.
- Aarhus University: *Genvej til ny viden* (Shortcut to new knowledge). Founded in order to improve the number of SMEs that collaborate with the university about innovation. In this initiative, the focus is on facilitating the meeting between enterprise and researcher throughout the course of the collaboration.
- Roskilde University: RUCInnovation. An entry point for SMEs to find researchers, students and collaborations.

- University of Southern Denmark: *SDU Erhverv* (SDU Business). A unit that provides technological development and feedback, tailored scientific continuing education and access to students, graduates and scientific environments through different types of collaboration.
- University of Copenhagen: A collaboration with the GTS institutes in order to contribute to the growth in SMEs.
- Technical University of Denmark: DTU Match. A professional service where the specific needs of an SME are clarified in order to focus scientific competencies. DTU Match was founded in 2008 and is now closed.

Source: (Danske Universiteter, 2014)

As these examples demonstrate, the main ways to disseminate scientific knowledge offered by Danish universities are primarily for SMEs that spontaneously experience a need to engage in collaboration in order to solve a specific problem. But what about the SMEs that do not spontaneously and through their own initiative seek out scientific knowledge? And what about scientific knowledge in general as opposed to scientific knowledge applied to a specific problem? As already mentioned, Kjærgaard (2006) states that non-scholars rarely look up scientific knowledge spontaneously. In conclusion, while I agree that universities are 'concerned' with the topic, whether or not 'they do a good job' I find more debatable. Accordingly, this thesis will explore how universities can improve the dissemination of scientific knowledge to SMEs in general, including those that do not spontaneously look for it, and in forms other than personalised collaborations regarding a specific problem.

1.5 GENERIC PATHWAYS

Today, a variety of channels are used for the dissemination of scientific knowledge. These include what is commonly referred to as *relational pathways* requiring interaction between the knowledge creator and the recipient enterprise (e.g. employed staff, consultants from universities, contract research and development) and *generic pathways* (e.g. published research, patents, research facilities, employed new graduates) (de Zubielqui et al., 2015).

In accordance with the research aim, the purpose of this thesis is to explore how scientific knowledge can be disseminated to SMEs specifically using generic pathways. There are three reasons for this. First, as I mentioned in the beginning of this chapter, it has been a predefined condition for the PhD project since its launch that it explored the dissemination of *existing* scientific knowledge from the online Research Information Management System (VBN) of Aalborg University's Library as a case. Second, existing literature and practices tend to focus on relational pathways to mediate between universities (researchers and students) and SMEs. Third, previous studies have found that SMEs in particular tend to be most likely to acquire scientific knowledge using generic pathways (de Zubielqui et al., 2015).

Using Research Information Management Systems to manage and disseminate scientific knowledge, e.g. publications, datasets, and professional activities, is an option chosen by all of the Danish universities, including Aalborg University. The idea of such a system is to gather all scientific knowledge in one place, thus enabling society and businesses to access it. A popular system used to manage scientific data is the Pure research intelligence system, developed by Elsevier. The purpose of the Pure system is threefold: To enable, conduct and share research (Elsevier, n.d.-b). Enabling research means to secure funding, identify and recruit researchers and establish partnerships; to conduct it means to discover, read, review, analyse, synthesise and so on; and to share it means to manage data, publish and disseminate data, and to commercialise and promote it. When using Pure, universities can build reports, carry out performance assessments, manage researcher profiles, enable research networking and more. Furthermore, Pure is made to reduce the administrative burden for researchers, faculty and staff. Besides Aalborg University, 53 other Danish organisations, including all of the higher educational institutions and several hospitals and libraries, use Pure implementations (Elsevier, n.d.-a).

At Aalborg University, the Research Information Management System building on Pure is called VBN (Knowledge Base of Northern Jutland). VBN can be considered a primary channel for disseminating scientific knowledge, because it is the institutional repository of Aalborg University and it serves as an online full text archive (VBN Editorial Office, n.d.). All scientific publications, projects, activities and press cuttings from Aalborg University are registered and made publicly available via VBN. However, there appears to be a basis for optimising the use of it. During meetings related to the start-up of the PhD project, the VBN Editorial Office expressed a desire to optimise SMEs' use of the portal in particular. As stated by the VBN Editorial Office (n.d.), the intention behind VBN is to make scientific knowledge from Aalborg University *available*. The intention of this thesis is to make the scientific knowledge not only available but to optimise the dissemination of it and ensure that it is also deemed relevant and used by SMEs. What this requires will be explored throughout the thesis. To do this, the thesis will explore how Pure data (existing scientific knowledge) from the VBN database can be subtracted and disseminated to SMEs via a new, generic pathway.

1.6 RESEARCH QUESTION

This research project is based on the fundamental assumption that *scientific knowledge is in fact relevant to SMEs*. Of course, this assumption can be challenged and could even serve as a subject for further research itself, but within this thesis it will serve as the point of departure. Furthermore, as I have argued throughout the introduction, the thesis is founded on a belief that new solutions for the dissemination of scientific knowledge between universities and SMEs must be explored. By that, a notion on 'optimisation' resides in the research aim. To disseminate is not only to send, it is also to receive. And to receive is not only to physically or virtually access something, it is also to understand it, find it relevant and be capable of using it. These understandings profoundly affect the research question.

To reiterate, the research aim of the thesis is to (1) examine, (2) develop and (3) evaluate a new concept for the dissemination of scientific knowledge to SMEs. Based on this aim, as well as the abovementioned contextual and predefined circumstances, the thesis sets out to contemplate and answer the following research question:

HOW CAN EXISTING SCIENTIFIC KNOWLEDGE BE DISSEMINATED TO SMES USING GENERIC PATHWAYS?

As mentioned previously, some conditions are prerequisite to answering the research question. First, using 'existing' scientific knowledge will be done in the form of Pure data from the VBN database. Secondly, this thesis focusses on the dissemination of scientific knowledge in a Danish context. More specifically, it focusses geographically on the northern part of Jutland, where Aalborg University is (mainly) located. Accordingly, SMEs from Northern Jutland will make out the empirical units included in the research.

1.7 PRESENTATION OF KEY TERMS

There are four key terms in this thesis, as the research question illustrates: (1) scientific knowledge, (2) knowledge dissemination, (3) SMEs and (4) generic pathways. While the SME definition and the understanding of generic pathways have already been unfolded, the two remaining terms require further presentation. I will give a short introduction to them and then elaborate and discuss them thoroughly in Chapter 2.

'Scientific knowledge', which is a type of knowledge, calls for a definition. However, conventional understandings about the nature of knowledge are not without their difficulties. The theoretical understanding of the term knowledge varies a great deal depending on perspective, and there are several assumptions about the location of knowledge, i.e. in bodies, routines, brains, dialogue or symbols (Blackler, 1995). Within this thesis 'existing scientific knowledge' is understood as explicit (Polanyi, 1966), encoded (Blackler, 1995); formal (Collins, 1993); physical (Andriessen, 2006); "know-that" (Ryle, 1949) and demonstrative (Aristotle, Brown, & Ross, 2009). While this will be elaborated on in Chapter 2, it is mentioned here in order to make clear that this thesis explores the dissemination of knowledge that is codified and can be disseminated across time and space encoded in tangible forms, i.e. scientific publications and journals, reports, statistics, information about researchers or research groups, scientific podcasts or vodcasts. In connection, another assumption surfaces regarding the 'genres' of scientific knowledge that are addressed within the area of study. I expect that knowledge from the natural sciences will generally be considered more relevant to disseminate than knowledge from the social sciences and especially from the humanities. Agrawal (2001, p. 286) supports this assumption: "Perhaps the two most active areas of university knowledge transfer are the life sciences and electronics, including electrical engineering and computer science." As a consequence of this assumption, the thesis deliberately involves all genres of scientific knowledge in the examination processes.

'Knowledge dissemination' also requires further discussion. To disseminate knowledge is to spread out knowledge, to make it available, to share it with someone. By that, dissemination of scientific knowledge is a type of communication. Communication (lat. *communicare*) means to exchange information, to make something common, or to share insights with someone. To communicate is to convey meaning between two or more parts, thus making comprehension possible. A very varied terminology exists related to knowledge dissemination, of which this introduction is illustrative. In existing literature, several different terms are used more or less synonymously with 'knowledge dissemination'. The most common of these are: Knowledge transfer (Agrawal, 2001); Knowledge Exchange (Acworth, 2008); Technology Transfer (Bozeman, 2000); Knowledge brokering and Knowledge translation (Bielak, Campbell, Pope, Schaefer, & Shaxson, 2008); Science communication (Bucchi & Trench, 2014); and Knowledge spillovers (Audretsch et al., 2004). More exist. While defining more or less the same process, the different terms also entail varying understandings and valuations. For example, the terminology of 'knowledge transfer' implies that knowledge can simply be transferred from one party to another, who then passively receives it. This echoes the transmission paradigm, where a sender's message (stimulus) causes a similar response (Heath & Bryant, 1992). This understanding has been widely critiqued and is commonly considered outdated. Today, it is commonly acknowledged that the dissemination of scientific knowledge is an interactive two-way transaction, where meaning is created through interaction. In this perspective, scientific knowledge cannot simply be transferred from university to SMEs. Both parts are actively influencing the process, ascribing it meaning and, accordingly, the process must be beneficial and meaningful to both parties (Carayannis, Alexander, & Ioannidis, 2000). For that reason, understanding the point of view of SMEs is valuable to the research conducted in this thesis. I will elaborate on this when describing the Research Design in Chapter 3.

1.8 AN EXPLORATORY STUDY

The research conducted in this thesis is primarily of an exploratory character. In asking *how* scientific knowledge can be disseminated to SMEs, the goal is not only to examine how it is done at present, but also to explore how it can be done in the future. Understanding SMEs' preferences and requirements for the dissemination process will be a central part of the thesis' contribution. That means that the thesis will explore what is required in order for SMEs to find scientific knowledge accessible, understandable, relevant and usable. This will include exploring how scientific knowledge could and should be presented. As a consequence, communicative principles for the optimised dissemination of scientific knowledge to SMEs will be created. These will be based on an examination of the current situation and they will be used to develop an actual generic pathway that makes possible a concrete exploration of how existing scientific knowledge from the VBN database can be disseminated to SMEs. Developing such a generic pathway is a way to concretise the exploration of the thesis, also enabling an evaluation of whether the dissemination of scientific knowledge is optimised according to SMEs. Collectively, this sums up the research aim of the thesis: To examine, develop and evaluate a new concept for the dissemination of scientific knowledge to SMEs.

1.9 SUB-QUESTIONS

To support the exploration acquired by the research question and the research aim, a line of sub-questions can be outlined:

SQ1. What problems and solutions are known and addressed in relation to the dissemination of scientific knowledge to SMEs?

Examining existing literature within the area of study is an important first step. Analysing and categorising the known barriers and solutions to the dissemination of scientific knowledge to enterprises (including SMEs) will serve as a foundation for further explorations.

SQ2. What characterises the situation of SMEs and their relation to (scientific) knowledge?
Analysing the situation of SMEs related to knowledge in general, and scientific knowledge in particular, will provide insights about the perspectives of SMEs and their preferences regarding external knowledge acquisition. Such insights are fundamental in order to explore and develop a new generic pathway that disseminates scientific knowledge according to SMEs' preferences.

SQ3. What are the communicative principles for the dissemination of scientific knowledge to SMEs?
Creating some communicative principles for the dissemination of scientific knowledge to SMEs is a concrete contribution of the thesis. These principles will provide concrete instructions for how scientific knowledge could and should be disseminated to SMEs. When a new generic pathway is developed later in the thesis, these principles will be used to present and reorganise the scientific knowledge.

SQ4. How is existing scientific knowledge presented and organised in a Research Information Management System (a generic pathway), and how does it correlate with the preferences of SMEs?
Examining and exemplifying a Research Information Management System and its content (scientific knowledge) will allow for a characterisation of 'existing scientific knowledge'. Further, it can initiate a discussion on how the presentation and organisation of scientific knowledge correlates with the preferences of SMEs.

SQ5. How can a generic pathway disseminate scientific knowledge based on an understanding of the situation and preferences of SMEs?
Developing a new generic pathway based on the perspectives and preferences of SMEs will allow for a concrete exploration and exemplification of how existing scientific knowledge can be disseminated to SMEs.

SQ6. To what extent does the generic pathway that is based on an understanding of the situation and preferences of SMEs optimise the dissemination of scientific knowledge to SMEs?
Evaluating the generic pathway will provide insights as to whether or not it optimises the dissemination of scientific knowledge. By optimise, I refer to whether it makes scientific knowledge more accessible, understandable, relevant and usable to SMEs. This subquestion thus adds a final perspective to the exploration of how existing scientific knowledge can be disseminated to SMEs.

These sub-questions require different types of insights. Some call for theoretical examination and others for empirical exploration. Therefore, a line of different studies will be conducted throughout the thesis.

1.10 THE SIX STUDIES OF THE THESIS

The thesis consists of six different studies.

Study A: Literature Study
In this study, the state of art in knowledge dissemination between higher educational institutions (including universities) and enterprises (including SMEs) is reviewed. The study is a systematic review of existing literature within the area of study, pointing out both well-known and understudied themes.

Study B: Studying the situation of SMEs in relation to (scientific) knowledge
Through this qualitative study, the situation (circumstances and conditions) of eight Danish SMEs and their relation to (scientific) knowledge are explored. In the study, the fundamental conditions of being an SME, how SMEs relate to (new) knowledge, and SMEs' perspectives on universities and scientific knowledge are examined.

Study C: Studying a Research Information Management System
Throughout the thesis, the Pure data from the VBN database, which is a Research Information Management System, serves as the example of existing scientific knowledge. In this study, the VBN database and its content, functionalities and organisation of knowledge are analysed in order to make clear what possibilities and obstacles exist when this data has to be subtracted and disseminated through a new generic pathway.

Study D: Workshop study
In this study, different stakeholders are invited to participate in generating ideas for a new generic pathway. The Workshop Study is organised in collaboration with a professional digital agency, and the participants include employees from different SMEs, researchers from Aalborg University, a consultant from Aalborg University Library and product managers from Elsevier. The goal of the study is to develop ideas for a new generic pathway that should disseminate scientific knowledge to SMEs.

Study E: Usability Study
Based on insights from the previous studies, an interface will be developed. The interface is an example of a generic pathway and it concretises how existing scientific knowledge can be disseminated to SMEs. Through this study, seven usability tests are completed in order to test different parameters and functions

of the interface. The goal of this study is to improve the generic pathway and learn more about how SMEs use it. These understandings will be used to make alterations to the generic pathway before 'launching' a prototype of it for evaluation.

Study F: Evaluation Study
In this final study, the generic pathway is evaluated. The Evaluation Study consists of an online survey and the respondents are SMEs from Northern Jutland. The study seeks indications to SMEs' immediate attitudes towards the interface and to learn whether they find that this way of disseminating scientific knowledge is successful.

Collectively, these studies constitute an exploration (examination, development, evaluation) of how existing scientific knowledge can be disseminated to SMEs using generic pathways. The research design and considerations about specific methods applied in the individual studies will be elaborated on in Chapter 3.

CHAPTER 2: DEFINING KNOWLEDGE AND KNOWLEDGE DISSEMINATION

In this chapter, I will discuss and define 'knowledge' and 'knowledge dissemination', which are central terms in this thesis. As mentioned in Chapter 1, it was a predefined condition of the thesis that it explored the dissemination of *existing* scientific knowledge (Pure data) from VBN, which is the online Research Information Management System of Aalborg University. Because of this, a particular type of knowledge and knowledge dissemination is addressed within this thesis, which will be clarified throughout this chapter.

The chapter will begin with discussing and defining the concept of 'knowledge'. However, establishing a conventional understanding of knowledge is not without difficulties. It is a complex concept that ranges far and wide across scientific disciplines. Because of that, the purpose of this chapter is not to conduct exhaustive philosophical discussions, but rather to profile the thesis' understanding of knowledge. By that, the goal is to understand what it is that this thesis will explore the dissemination of, which is central to the thesis' research question. I will strive to conceptualise the thesis' understanding of knowledge primarily by referencing 'general' and somewhat classical definitions and typologies of the concept of knowledge. This will also be used to define the concept of 'knowledge-intensive enterprises', which will turn out to be relevant to the research conducted in this thesis. As I will show, using existing scientific knowledge from VBN entails that the thesis explores the dissemination of a somewhat atypical type of knowledge compared to the prevalent one within this area of study.

The second part of the chapter will focus on defining the thesis' understanding of 'knowledge dissemination'. As stated in Chapter 1, I understand the dissemination of scientific knowledge as a type of communication. While this might seem to be an obvious statement, it is, however, not an understanding I have found explicitly drawn in existing science-society literature. Generally speaking, within knowledge dissemination as a scientific discipline, the communicational and humanistic orientation is not that common. A social scientific perspective is indeed more prevalent. Addressing dissemination of scientific knowledge as a *communication* problem adds a new perspective on how the concept of knowledge dissemination can be understood and addressed. For that reason – and because it can profile the thesis' understanding of the dissemination process – I commit myself to making the connection between dissemination and communication clear in this chapter. Accordingly, looking at the concept of communication will be a substantial part of the second half of this chapter.

2.1 THE CONCEPT OF KNOWLEDGE

I will begin the conceptualisation of knowledge with some perspectives on the diverse nature of the concept. According to Nonaka (1994), knowledge is a multifaceted concept with multi-layered meanings dating back to the classical Greek period. As mentioned by Alvesson (1993), it seems extremely difficult to define knowledge in a non-abstract and non-sweeping way. Knowledge, he says, easily becomes everything and nothing. In the *Theaetetus* (see for example Chappell, 2013), Plato was the first to raise epistemological discussions on the concept of knowledge and asked questions such as: What is knowledge? Where does knowledge come from? And how do we know that we have knowledge? Although the *Theaetetus* did not arrive at a definition of knowledge, it did discuss 'truthfulness' as an essential attribute of knowledge. Along this line, Nonaka (1994, p. 17) defined knowledge as "justified true belief". These understandings of knowledge represent a traditional epistemology, where knowledge is manifested through an individual's senses and memories. It stands opposed to a pragmatic epistemology, where knowledge is manifested through actions and a physical interaction between individuals and their surroundings. Nonaka (1994) explained that while knowledge has traditionally been seen as something absolute, static and non-human, more recent theories on knowledge creation see knowledge as a dynamic human process of justifying personal beliefs as part of an aspiration for the 'truth'. Along the same lines, Blackler (1995) suggested that rather than regarding knowledge as something people *have*, knowing is better regarded as something people *do*. In this perspective, a distinction is drawn between knowing and knowledge; we can know something rather than have knowledge about something. According to Blackler (1995, p. 1021), knowing is "an active process that is mediated, situated, provisional, pragmatic and contested".

To begin the profiling of the thesis' understanding of knowledge, I will present some perspectives that offer different categorisations of the concept. According to Andriessen (2006), thinking about knowledge requires metaphors. When working on identifying common metaphors for knowledge, he analysed the definitions and characteristics of knowledge as addressed by what he claims are the two most cited publications in the knowledge management literature: *The Knowledge-Creating Company* (Nonaka & Takeuchi, 1995) and *Working Knowledge* (Davenport & Prusak, 2000). This resulted in a typology of metaphors for knowledge, which is illustrated in Figure 2.1.

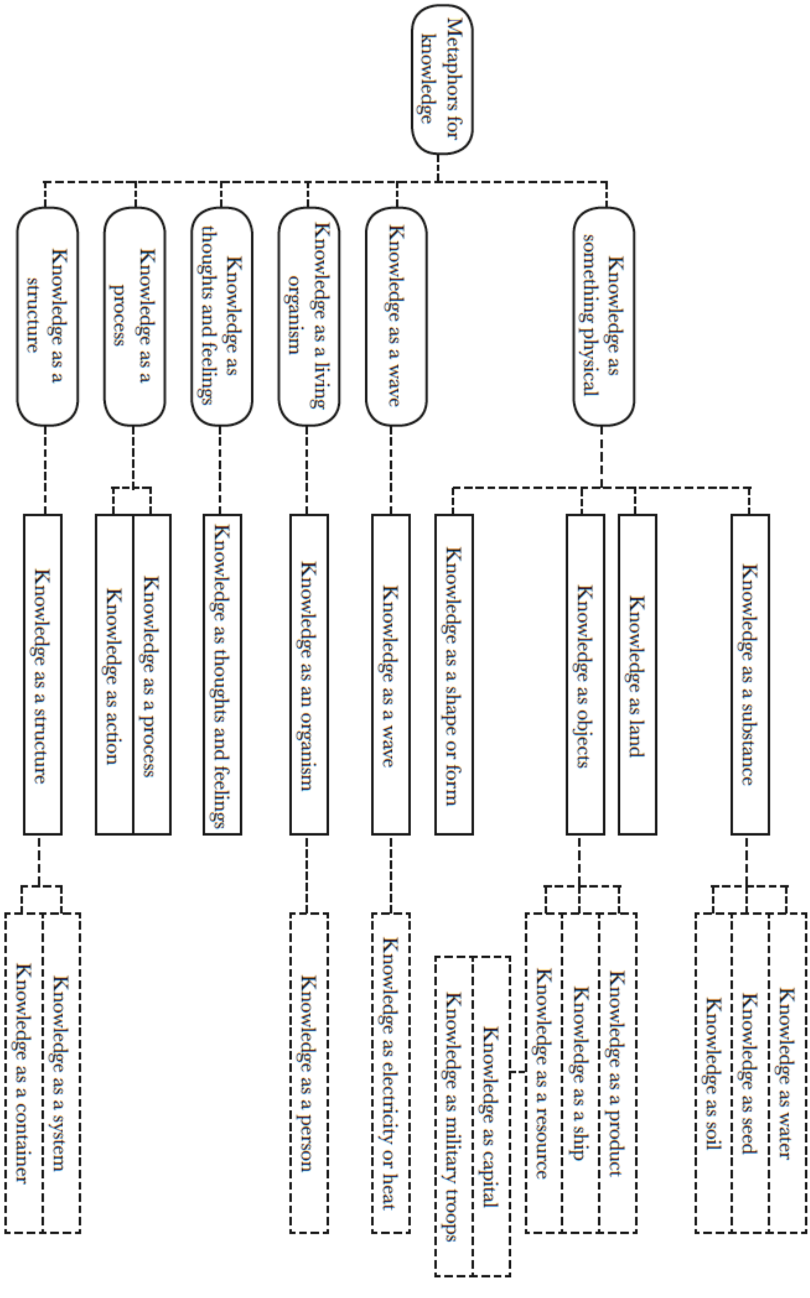

Figure 2.1. Metaphors for knowledge. Source: Andriessen (2006, p. 97)

As the figure illustrates, knowledge is an abstract concept that can be viewed and conceptualised in many different ways. Andriessen (2006) identified six types of metaphors, ranging from physical metaphors (knowledge as something physical) to abstract metaphors (knowledge as a structure). To approach an understanding of which metaphor applies within this thesis, I will briefly elaborate on each of these six metaphors. First, understanding knowledge as something physical means to consider it as something that can be located, moved and exchanged. In this perspective, knowledge can be a thing and it can be stored, formed and moved. Second, understanding knowledge as a wave means to consider it as something that can be generated, amplified and diffused. In this perspective, knowledge has a physical referent but cannot be seen or touched. Third, understanding knowledge as a living organism means to consider it as something that exists, develops and can move. In this perspective, knowledge can be a person. Fourth, understanding knowledge as thoughts and feelings means to consider it as something less physical, i.e. bodily experience and ideas. By that, an intangible nature of knowledge is indicated, which introduces the question of how to transfer knowledge, which I will get back to. Fifth, understanding knowledge as a process means to consider it a dynamic human process of justifying personal belief toward the truth (Nonaka & Takeuchi, 1995). This relates to the earlier mentioned definition of knowledge as 'justified true beliefs' by Nonaka (1994). Finally, understanding knowledge as a structure is the most abstract metaphor and covers the idea that knowledge has a structure that allows it to contain something; that knowledge is like a system and consists of (cognitive) elements that can be arranged in a particular form.

Out of these six metaphors, knowledge as something physical, i.e. objects or products that can be shaped or formed, is descriptive to the thesis' understanding of knowledge. To disseminate scientific knowledge in the form of Pure data (using generic pathways) is to give knowledge a physical form and thus make it possible to move it between actors (universities and SMEs). Accordingly, because of the predefined conditions of the PhD project, knowledge must be understood and addressed as something physical, although it differs from the prevalent understanding of knowledge within existing science-society literature. As I will elaborate on later in the chapter, the understanding of knowledge as something more abstract and embodied tend to dominate in the field, which is why dissemination of that type of knowledge has also been given more focus. However, it is the (scientific) knowledge that can in fact be put into form (in the concrete form of Pure data) that this thesis explores the dissemination of. This does not mean that I do not acknowledge knowledge as having an abstract and intangible character. Rather, it entails that I will not engage in discussions on how the receivers of the knowledge dissemination understand and transform the knowledge. It is the *dissemination* of physical knowledge itself this thesis will examine. In the following section, I will discuss some classical typologies of knowledge in order to elaborate on the thesis' conceptualisation of knowledge.

2.1.1 IMAGES OF KNOWLEDGE

Andriessens (2006) metaphorical understandings of knowledge as something physical and at the same time something abstract and intangible introduce the classical distinction between two types of knowledge: tacit and explicit knowledge. This distinction was originally introduced by Polanyi (1966) and covers the idea that 'we can know more than we can tell', which relates to the metaphorical understanding of 'abstract knowledge' addressed above. According to Polanyi (1966), most of our knowledge is tacit and cannot be put into words. This is supported by Nonaka (1994), who stated that knowledge that can be expressed in words and numbers only represents the tip of the iceberg of the entire body of possible knowledge. While tacit knowledge is hard to formalise and disseminate, explicit knowledge *can* be put into words. It is codified and transmittable and can be captured in records such as documents and files (physical). Because explicit knowledge can be captured in records such as books, manuals or archives it is evidently easier to disseminate and share. That might also explain why existing literature tends to focus on the dissemination of tacit knowledge; the challenge of disseminating tacit knowledge is (also) relevant to find solutions for. However, although capturing explicit scientific knowledge is evidently easier than capturing tacit knowledge, that does not mean that it is easy to disseminate it – not in general and not to SMEs in particular.

Accordingly, this thesis explores the dissemination of explicit knowledge. Again, that does not mean that I do not acknowledge the tacit (or abstract) dimension of knowledge. However, because it is a defined condition of the thesis that it explores how existing scientific knowledge, which is available in VBN, can be disseminated, it is evident that the thesis engages in the dissemination of physical, explicit knowledge. What form this knowledge takes and how it is organised and presented will be analysed in Chapter 6.

Another classical typology of knowledge is found with Aristotle, who stated that there are five states by virtue of which the soul possesses truth by way of affirmation or denial. This is a complicated way of saying that there are five types of knowledge: Art (*techné*), scientific knowledge (*episteme*), practical wisdom (*phronesis*), philosophical wisdom and intuitive reason (Aristotle et al., 2009). To Aristotle, art (*techné*) is knowledge about craftsmanship; about how to make things. Scientific knowledge (*episteme*) is the demonstrative knowledge and judgements of the universal, the necessary and the eternal. It is theoretical, abstract and general knowledge about the world, its structure and its processes. Practical wisdom (*phronesis*) is concerned with things human and things about which it is possible to deliberate. It is a true and reasoned state of capacity to act with regard to the things that are good or bad. Accordingly, it is about judgement, practically oriented towards action. Wisdom, be it intuitive or philosophical, is considered the most finished of the forms of knowledge. According to Aristotle, practical wisdom is intuitive and cannot always be articulated. By that, a parallel to 'tacit knowledge' can be drawn. The scientific knowledge (note that it is not the same meaning of scientific knowledge as the one adopted in this thesis), on the other hand, is demonstrative, by which a parallel to 'explicit knowledge' can be drawn. Accordingly, what this thesis regards as scientific knowledge may also be characterised as scientific knowledge (*episteme*) in Aristotle's terms.

Another image of knowledge is found in Ryles' (1949) classical distinction between 'knowing how' (know-how) and 'knowing that' (know-that). This distinction points out the difference between learning *how* to do something and learning *that* something is the case. Or as SMEs will describe the distinction later in this thesis: There is a difference between knowing how to perform a task or a job-related problem and knowing that the market, the behaviour of the consumers, the theories, the credit policies, the rules and regulations, the prices and so on tend to be this and that way (see Section 5.3.1). While know-how can be measured by certain standards of success or failure (we can know how to perform a job-related task *well*), know-that is the type of knowledge you can read about. By that it is clear that know-that is the explicit knowledge, the scientific knowledge. Know-how, on the other hand, can be referenced as tacit knowledge in Polanyi's terms and practical wisdom in Aristotle's terms. According to Polanyi (1966), 'knowing that' and 'knowing how' collectively amounts to knowing; they are two aspects of knowledge that have a similar structure.

Collins (1993) operates with a fundamental division between 'tacit' knowledge, which in his definition is knowledge that appears to be located in society, and 'formal' knowledge, which is knowledge that can be transferred in symbolic form and encoded into machines and other artefacts. He further identifies four types of knowledge/abilities/skills: (1) Symbol-type knowledge; (2) Embodied knowledge; (3) Embrained knowledge; and (4) Encultured knowledge. This categorisation was adapted and extended by Blackler (1995), who, in turn, identified five images of knowledge and distinguished them by the assumptions they make about the location of knowledge, i.e. in bodies, routines, brains, dialogue or symbols: (1) Embrained knowledge, which is knowledge that is dependent on conceptual skills and cognitive abilities; (2) Embodied knowledge, which is knowledge that is action oriented and is likely to be only partly explicit; (3) Encultured knowledge, which refers to the process of achieving shared understandings; (4) Embedded knowledge, which is knowledge that resides in systemic routines; and (5) Encoded knowledge, which is knowledge that can be conveyed by signs and symbols. While embrained knowledge corresponds to know-that and embodied knowledge correspond to know-how, encoded knowledge corresponds to what was labelled explicit and physical knowledge above. It can also be categorised as scientific knowledge (*episteme*) in Aristotle's terms, seeing as encoded knowledge conveys or transmits information through codes, i.e. books or manuals. Accordingly, encoded knowledge is the type of knowledge this thesis seeks to disseminate to SMEs.

With references to different images and typologies of knowledge, I have approximated an understanding of what type of scientific knowledge is addressed within this thesis. In this thesis, the goal is not to discuss how knowledge is created nor how it is absorbed in organisations, although these are important questions in the knowledge management literature. Rather, discussing the nature of knowledge has an instrumental goal of defining what it is I seek to explore the dissemination of. While tacit and abstract knowledge surely plays a vital role in scientific knowledge production, it does not exist in a tangible form in VBN. That scientific knowledge is considered to be physical, explicit, demonstrative and encoded indicates that it is knowledge products (in various forms) that will be used for the exploration of the thesis.

2.1.2 KNOWLEDGE-INTENSIVE ENTERPRISES

As a consequence of society's increased focus on the value and importance of knowledge, the number and significance of 'knowledge-intensive organisations' has increased (Alvesson, 1993). According to Alvesson (1993), the distinction between professionals and non-professionals has been seriously weakened, which has led to an increase in occupations that might be founded in higher education but which does not correspond to a strict definition of 'professions'. In other words, more and more enterprises make a living out of professional knowledge and 'knowledge-intensive' work. However, as noted by Starbuck (1992), a knowledge-intensive firm is not necessarily a professional firm, although it may be. Being a knowledge-intensive firm depends on the people employed there; they might be experts and apply specialised expertise to the firm. A similar point was raised by Nonaka (1994), who stated that knowledge is fundamentally created by individuals, and that organisations cannot create knowledge without individuals. The employees translate their accumulated knowledge – their know-how and know-that as well as their tacit and explicit knowledge – into the firms' routines, plans, strategies and cultures, by which the firms' knowledge-intensity increases.

According to Starbuck (1992), a knowledge-intensive firm is one that has technical and strategic expertise and where the key labour inputs come from the employees rather than from machines or technologies. In knowledge-intensive firms, the key input (and output) is expertise. As opposed to capital-intensive firms, where capital is the primary input, or labour-intensive firms, where labour has the greater importance, in knowledge-intensive firms, knowledge has more importance than other inputs and outputs. In knowledge-intensive firms, exceptional and valuable expertise (knowledge) must not only exist but also be used to attain extraordinary strategic advantages.

Based on a review on knowledge work literature and on the distinction between embodied, embedded, embrained and encultured knowledge, Blackler (1995) distinguishes four types of organisations with a different emphasis on knowledge. Figure 2.2 illustrates the distinction between the four types of organisations or knowledge types. The distinction regards (1) whether the organisation focusses on problems of a routine kind or is preoccupied with unfamiliar issues and (2) if the organisation depends heavily upon the contributions of key individuals or is more obviously dependent upon collective effort. The result of this is the characterisation of four types of organisations which depend differentially on knowledge. As the figure shows, the knowledge-intensive firm is characterised as an organisation which focusses on novel problems and emphasises the embrained knowledge (know-that) of key individuals (i.e. employees).

The understanding of some enterprises, including SMEs, being 'knowledge-intensive' is of relevance to this thesis. Seeing as the thesis' research question focuses on exploring how existing scientific knowledge can be disseminated to SMEs, finding SMEs to whom scientific knowledge is potentially of value is essential. This is a strategic decision. Naturally, not all enterprises will find scientific knowledge relevant, which is also not the point. The point is to improve the dissemination of scientific knowledge to SMEs that can potentially find it relevant. Here, the understanding of knowledge-intensive firms is useful because it can be used to categorise and select relevant SMEs for the studies of the thesis. Methodological considerations about the selection of SMEs will be elaborated on in Chapter 3.

2.1.3 SUMMARY: DEFINING 'SCIENTIFIC KNOWLEDGE' FOR THE PURPOSE OF THE THESIS

As this theoretical discussion has illustrated, the concept of knowledge is challenging to conceptualise. As stated by Blackler (1995, p. 1032), "Knowledge is

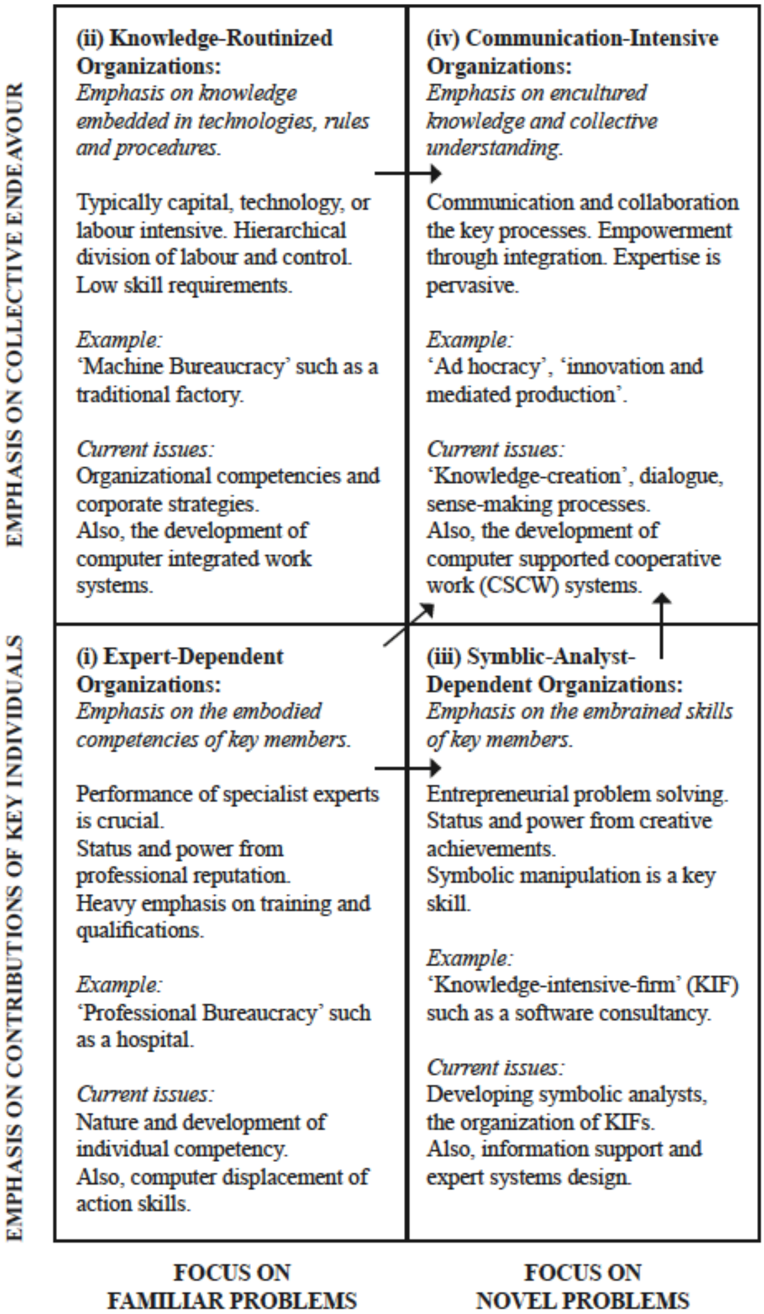

Figure 2.2. Organisations and knowledge types. Source: (Blackler, 1995, p. 1030).

multi-faceted and complex, being both situated and abstract, implicit and explicit, distributed and individual, physical and mental, developing and static, verbal and encoded". The discussions above bear witness to this.

Seeing as this thesis explores how existing scientific knowledge in the form of Pure data from VBN can be disseminated to SMEs, it operates with an understanding of knowledge as explicit (Polanyi, 1966), encoded (Blackler, 1995), formal (Collins, 1993), physical (Andriessen, 2006), know-that (Ryle, 1949) and demonstrative (Aristotle et al., 2009). This may sound very categorical. It is not to say that scientific knowledge is understood as not containing other aspects of knowledge. Naturally, scientific knowledge also consists of know-how, tacit knowledge, embodied knowledge and so on. However, the point of this characterisation of scientific knowledge is to underscore that the knowledge addressed in this thesis are actual knowledge products that can be explicitly formed, moved and expressed in different codes or products (Pure data), i.e. journal articles, research units, press clippings or descriptive keywords (see Chapter 6 for an analysis of the content in VBN).

2.2 PROFILING 'KNOWLEDGE DISSEMINATION'

Now that knowledge has been defined for the purpose of this thesis, the next step is to look into what it means to *disseminate* knowledge. To disseminate is to distribute, to circulate or to spread out. As a term, however, 'dissemination' lacks a commonly accepted definition. When conducting a wide-ranging literature search, Friedman and Farag (1991) were unable to locate a comprehensive and commonly accepted definition of the term. Instead, they found that the dissemination terminology depended on discipline: In psychology literature, for example, dissemination is frequently referred to as information transfer or knowledge transfer; in fields such as agriculture and education, dissemination is also called technology transfer; in the marketing arena, dissemination may be found under terms such as advertising, sales, promotion, market segmentation, social marketing and consumerism. Although I have not conducted a systematic study of the terminology, I have contemplated the diverse terminology within the science-society literature. To list some of the terms I have encountered when reading this type of publication: Information transfer, Knowledge collaboration, Knowledge brokering, Knowledge creation, Knowledge exchange, Knowledge dialogue, Knowledge transfer, Knowledge sharing, Knowledge spill-overs, Knowledge spin-off, Knowledge translation, Science communication, Science journalism and Technology transfer. Such a diverse use of terms makes it difficult to manoeuvre, seeing as it can be challenging to tell them apart and because the use of these terms varies. For example, the term ‘knowledge transfer’ is often interchanged with ‘knowledge dialogue’, ‘knowledge exchange’ and ‘knowledge translation’ (Lockett, Cave, Kerr, & Robinson, 2009), which adds to the confusion. It also points out that while these terms may cover slightly different understandings, they are also often used synonymously, simply to describe some sort of interaction between university and industry.

This thesis deliberately uses the term ‘dissemination’ over the other options. While knowledge transfer is a very well-used term within this area of study, its terminology reflects a one-way flow of information, where knowledge is simply transmitted from one party to another. However, the use of this term is usually not that black and white, seeing as definitions of knowledge transfer often require the knowledge to be not only transferred but also utilised, which for example requires communication (see for example Heinzl, Kor, Orange, & Kaufmann, 2013). On the contrary, a term such as ‘knowledge exchange’ is defined as a two-way flow of information (see for example Acworth, 2008). Knowledge transfer and knowledge exchange can thus be said to represent two extremes. Using the context of this thesis to exemplify, it means that when scientific knowledge is *transferred*, it is simply moved from university to SME. When scientific knowledge is *exchanged*, it is moved from university to SMEs, obtained and possibly transformed by the SMEs and then exchanged back to the university. In continuation, I understand ‘knowledge dissemination’ as a middle path. I use the term ‘dissemination’ to stress that scientific knowledge must not simply be transferred from university to SMEs, but at the same time it will not exactly be exchanged. The thesis explores how scientific knowledge can be disseminated to SMEs, but not how a return flow of knowledge can happen. It relates to what I stated earlier in this chapter, that this thesis will not engage in discussions on how the receivers of the disseminated knowledge will understand and transform the knowledge. However, there is no doubt that when scientific knowledge is disseminated to SMEs (and when they understand and utilise it), they will transform and develop the knowledge and then it could be valuable to exchange it back to the university. But that perspective falls outside this thesis. Here, it is the dissemination process itself that will be explored (examined, developed and evaluated).

However, what all these different terms have in common is that they cover the process of *knowledge being passed on between parts*. By that, knowledge dissemination – and the range of similar terms – can be characterised as a process of communication. I will support this claim by reflecting on different aspects of the concept of communication, thus making the parallel clear. When doing this, the key concepts and assumptions that make up the anatomy of the dissemination process as viewed in this thesis will also be elaborated on, by which a definition of knowledge dissemination will be approximated.

2.2.1 THE CONCEPT OF COMMUNICATION

As was the case with the concept of knowledge, the concept of communication is also complex and wide-ranging. Communication is a term, a subject, a process, an action and a tradition that spans across professions and scientific disciplines. 'Communication' originates from the Latin word *communicatio* which means 'common' (making common) or 'sharing'. To communicate (lat. *communicare*), accordingly, is to share something or make something common. Through communication it is possible for individuals to share meaning by exchanging information or messages. To make meaning common means to convey it between two or more parts, thus making it comprehensible. By that, communication relates to understanding. According to Heat and Bryant (1992), the incentive behind communication is to achieve understanding, and according to Habermas (2000), the communicative action (as opposed to strategic action) is the type of action aimed at reaching mutual understanding (*verständigung*). In conclusion, to communicate is to make meaning common and achieve understanding. When disseminating knowledge, this is also the goal: To share the knowledge with another part and make the knowledge common.

As stated by Miller (1966) several decades ago, if any one word could accurately describe the dominant contemporary viewpoint regarding communication, it would be 'interdisciplinary'. This is still accurate. While communication is a scientific discipline, it is also commonly known as a practical discipline. Various professional fields, such as management, marketing, advertising and public relations, engage in the development and assessment of communication on behalf of organisations (Hallahan, Holtzhausen, Ruler, Verčič, & Sriramesh, 2007). While communication is interdisciplinary and covers a range of both scientific and practical disciplines, Oates (1964) stated that communication is ultimately a philosophical enterprise, although it tends to be forgotten. Habermas (2000) also addressed this and raised four validity claims that have to be abided by in order to participate in a process of reaching understanding (communication): The communicator must choose an intelligible expression in order to secure *comprehension*; the communicator must have the intention of communicating a *true* proposition in order for knowledge to be shared; the communicator must want to express his or her feelings truthfully in order to secure *credibility*; and the communicator must choose an utterance that is *right* (with respect to prevailing norms and values) in order to ensure acceptance and agreement. What these validity claims point out, and what understanding communication as a philosophical discipline results in, is that (ideally) communicators are obligated to be truthful, by which a reference back to Plato's epistemological considerations about knowledge is made (see Section

2.1). In this perspective, to disseminate scientific knowledge requires an intelligible, truthful and credible expression.

As this initial discussion is illustrative of, there are many perspectives on the subject and discipline of communication. Likewise, there are differences of opinions as to what communication actually is. DeVito (1986) stated that communication is either a process or an act. This introduces the distinction between two classical paradigms: The transmission paradigm and the interaction paradigm. The transmission paradigm covers the belief that a message can be transmitted from a sender to a receiver and that a sender's message (stimulus) causes a similar response (message reception) in the receiver. In this perspective, communication is an act, carried out by a sender. The interaction paradigm, on the other hand, thinks of communication not as a vehicle for transmitting messages, but as a means for interaction; as interaction through messages (Heath & Bryant, 1992). Here, interaction is understood as dialogue, reciprocity and mutual influence between sender and receiver. In this perspective, communication is a process where both sender and receiver play an active role in determining the meaning of the message. Accordingly, communication as an interactive process means that the process of reaching mutual understanding is based on dialogue and reciprocity between sender and receiver and that they are equally able to influence the process and determine the response of the message. Reflecting on these two paradigms demonstrates that profiling knowledge dissemination as a type of communication can entail different objectives.

2.2.2 CONSTITUENT ELEMENTS OF COMMUNICATION

There is no shortage of definitions of 'communication'. As stated by Dance (1970), it is difficult to determine whether communication is over-defined or under-defined. Drawing from diverse fields and publications, Dance (1970) set out to conceptualise the concept of communication by examining the multitudinous definitions. To be precise, he reviewed 95 different definitions of communication. From this, he identified 15 distinct conceptual components in communication. Table 2.1 illustrates each of these components, accompanied by an exemplifying definition.

Conceptual components	**Exemplifying definition**	**Source**
Symbols/ Verbal/Speech	"Communication is the verbal interchange of thought or idea."	(Hoben, 1954, p. 77)
Understanding	"Communication is the process by which we understand others and in turn endeavour to be understood by them. It is dynamic, constantly changing and shifting in response to the total situation."	(Andersen, 1959, p. 5)
Interaction/ Relationship/ Social Process	"Interaction, even on the biological level, is a kind of communication; otherwise common acts could not occur."	(Broom & Selznick, 1963, p. 107)
Reduction of Uncertainty	"Communication arises out of the need to reduce uncertainty, to act effectively, to defend or strengthen the ego."	(Barnlund, 1962, p. 200)
Process	"Communication: the transmission of information, ideas, emotions, skills, etc., by the use of symbols-words, pictures, figures, graphs, etc. It is the act or process of transmission that is usually called communication."	(Berelson & Steiner, 1964, p. 254)
Transfer/ Transmission/ Interchange	"… the connecting thread appears to be the idea of something's being transferred from one thing, or person, to another. We use the word "communication" sometimes to refer to what is so transferred, sometimes to the means by which it is transferred, sometimes to the whole process. In many cases, what is transferred in this way continues to be shared; if I convey information to another person, it does not leave my own possession through coming into his. Accordingly, the word "communication" acquires also the sense of participation. It is in this sense, for example, that religious worshipers are said to communicate."	(Ayer, 1955, p. 12)
Linking/ Binding	"Communication is the process that links discontinuous parts of the living world to one another."	(Ruesch, 1957, p. 462)
Commonality	"It (communication) is a process that makes common to two or several what was the monopoly of one or some."	(Gode, 1959, p. 5)
Channel/ Carrier/Means/ Route	"… the means of sending military messages, orders, etc. as by telephone, telegraph, radio, couriers."	("The American College Dictionary," 1964, p. 244)

Replicating Memories	"Communication is the process of conducting the attention of another person for the purpose of replicating memories."	(Cartier & Hanvood, 1953, p. 73)
Discriminative Response/ Behaviour Modifying/ Response/ Change	"Communication is the discriminatory response of an organism to a stimulus."	(Stevens, 1950, p. 689)
Stimuli	"Every communication act is viewed as a transmission of information, consisting of a discriminative stimuli, from a source to a recipient."	(Newcomb, 1966, p. 66)
Intentional	"In the main, communication has as its central interest those behavioural situations in which a source transmits a message to a receiver(s) with conscious intent to affect the latter's behaviours."	(Newcomb, 1966, p. 66)
Time/Situation	The communication process is one of transition from one structured situation-as-a-whole to another, in preferred design."	(Sondel, 1956, p. 148)
Power	'… communication is the mechanism by which power is exerted."	(Schachter, 1951, p. 191)

Table 2.1. Distinct conceptual components in the concept of communication. Source: (Dance, 1970, p. 204)

Dance (1970) reached the conclusion that the concept of communication is too loose and includes contradictory components. However, all the definitions from Table 2.1 have three factors in common, which I have put in the following formula:

> (1) Something – be it a message, a thought or an idea, information, emotions or skills, military orders, or power
> (2) has to be passed on – be it interchanged, transferred, transmitted, made common, linked, or sent
> (3) between two or more parts – be it on the biological level or between things, persons, or structured situations-as-a-whole.

This formula involves three basic constituent elements: A sender, a message (and the passing on of this message) and a receiver. It is the same three basic constituent elements that are involved in a dissemination process. Using the context of this thesis to exemplify: The university, scientific knowledge (and the dissemination thereof) and the SMEs. So, although the phenomena of communication is complex, its basic constituent elements are simple (Oates, 1964). Around these basic constituent elements, a countless number of communication models have been built (containing different versions of secondary elements, i.e. channel/medium, context or code). Such communication models especially illustrate how a communication process takes place and what players participate in the process. According to Frandsen (2011b), two generations of communication models exist. The first generation are the linear models, where the communication process is perceived as a linear, one-way process where communication happens *from* sender *to* receiver. These models are sender- and effect-oriented and are characterised by a functionalistic and instrumental view. A well-known example of such a model is Laswell's Formula for mass communication: Who? Says What? In which channel? To whom? With what effect? (Laswell, 1964). In this type of model, the context is ascribed little meaning and the receiver is perceived as a passive recipient of an intended message. The second generation of communication models are the circular models, where the communication process is perceived as dynamic, interactive and context-bound. In these models, the receiver is perceived as an active player who influences the communication process as much as the sender. Here, the meaning of the message is only created during the communication process and is not controlled by the sender. This distinction between linear and circular communication models clearly echoes the distinction between the transmission paradigm and the interaction paradigm. I will give an example that illustrates the distinction between these two types of models and paradigms related to dissemination of (scientific) knowledge. Collins (1993) asked the question: How is knowledge transferred? To answer that question, he drew a reference to how knowledge is transferred between computers. In computers, he stated, abilities are transferred in the form of electrical signals transmitted along wires or recorded on floppy disks. When knowledge is transferred from one computer to another, the second computer 'becomes' identical to the first as far as its abilities are concerned. However, when it comes to transferring knowledge between humans, it becomes more complicated. Embodied and tacit knowledge, for instance, cannot be transferred simply by passing signals from one brain/computer to another. A central understanding to take from Collins' comparison of computers and humans is that humans are unable to function in a machine-like way. Knowledge cannot simply be taken out of one person and put into another. Not even the explicit knowledge: Even though knowledge is explicitly put into codes and forms, there is no guarantee that the 'receiving' individual will understand the same as the individual who encoded it. For that reason, understanding communication as an interactive process is essential. This also happens to be by far the most modern understanding of communication because it ascribes value to the contexts and acknowledges that both sender and receiver are active participators in the process and co-creators of meaning. However, although the transmission view and the linear, one-way processes are widely criticised and commonly considered outdated – mainly because of the limited focus on context and receiver – the transmission metaphor is still being used, i.e. in journalism, public information and knowledge sharing (Frandsen, 2011a), and according to Falkheimer and Heide (2014) it might even still predominate in the western world. However, looking at knowledge dissemination particularly, the perspective within this area of study has generally undergone a transformation from deficit to dialogue (Besley & Tanner, 2011; Miller, 2001), and from a science-push to an information-pull (Bielak et al., 2008). This means that dissemination of knowledge has gone from a one-way, top-down perspective to a two-way, dialogical perspective, where attention is increasingly paid to how a 'pull' for information can be created from the 'receivers'. Accordingly, there is actually a tendency to understand the dissemination of scientific knowledge as an interactive (communication) process – although it is not always explicated.

For this thesis, understanding the dissemination of scientific knowledge as an interactive communication process means to accept that the university and the SMEs – the 'sender' and the 'receivers' – are equally able to influence the process and both play an active role in determining the meaning of the message. I enhanced 'sender' and 'receiver' to underline the self-contradictoriness of the sentence. When communication is perceived as a dynamic process by which people create meaning through interaction, the view on sender and receiver is blurred. Because communication cannot be reduced to a stimulus-response pattern, the traditional distinction between sender and receiver is outdated. Rather, sender and receiver should be labelled 'communication partners' or 'communication participants'. In the context of the dissemination of scientific knowledge, Siontorou and Batzias (2010) suggest to name them 'science base' and 'market base', which is also a way to avoid the traditional labels. Using the terms 'sender' and 'receiver' in the remaining part of the thesis is therefore a matter of convenience. Universities and SMEs do comprise two of the three basic constituent elements in the communication process. They are the ones between whom meaning flows. Because the university is the one with an *intention* to disseminate scientific knowledge *to* SMEs, the university takes on the traditional role of the sender while SMEs take on the traditional role of the receivers. It is also the university who (originally) identified a communication problem, namely that SMEs' use of existing scientific knowledge should be improved. On that note, Hall (1992) understands the sender as a player who sends a message in the *attempt* to influence a receiver to act in a certain way. This introduces the notion of 'intent', by which communication also becomes a strategic discipline.

2.2.3 COMMUNICATION AS STRATEGY

A basic aspect of all acts of communication is that they *direct attention* (Cartier & Hanvood, 1953). Directing attention might be done intentionally or unintentionally. Miller (1966) emphasised the notion of *conscious intent* related to communication. When communication is intended, a sender attempts to influence a receiver to act in a certain way. In other words, the sender attempts to predetermine the effects of his or her communication.

Because communication directs attention and because this can be done intentionally, communication is also a strategic discipline. Communication can be used strategically to attain specific goals, of which this thesis is an example. Exploring how to optimise the dissemination of scientific knowledge to SMEs is also a strategic endeavour. The university has an intention to optimise SMEs' use of scientific knowledge. This intention is brought on by something. As mentioned in Chapter 1, the increased societal and political attention on universities' responsibility to stimulate a greater awareness and exploitation of scientific knowledge outside academia has changed the societal role of universities and has placed an enormous resource pressure on them. Scientific knowledge has become a societal affair (The Ministry of Science, 2004) and, accordingly, universities need to do more to disseminate their scientific knowledge to different target groups, including SMEs. In that perspective, this entire PhD project can be seen as a strategic endeavour.

The concept of strategy is derived from the Greek word, *stratēgía*, which means generalship and is a compound of the two words, *strat(ós)*, which means army, and *ágein*, which means to lead. The concept was originally used in military theory and has since been adopted as a research discipline focussed on strategic communication as a phenomenon, i.e. to describe, explain, criticise and understand the practice of strategic communication and its impact on society, organisations and individuals (Falkheimer & Heide, 2014). When the Prussian general and military strategist Carl von Clausewitz first published the now classical work on warfare in 1832, he defined strategy as the employment of the battle as the means towards the attainment of the object of the war (Clausewitz, 1968). Strategy, he said, must give an aim to the whole military action, which must be in accordance with the object of the war. This applies to communication as well. Based on the perspectives above, I understand that to communicate strategically is to communicate purposefully, to have a goal and make sure that all actions are in line with the main objective. To communicate strategically is to communicate with the purpose of changing a situation and to have a direction (or at least attempted direction) for these changes. Strategy is about having an intended effect and choosing the resources and actions that allow for that effect to be realised. In the context of this thesis it means that if the dissemination of scientific knowledge to SMEs has to be optimised, actions that will make it more likely will have to be taken. This could, for example, be to understand the preferences of SMEs and change the dissemination pathways accordingly.

According to Kornberger (2013), strategy is a device for disciplining the future. Its proliferation, he stated, reaches into nearly all strata of society (firms, not-for-profit organisations, political parties, cities, states or networks); they all strategise to mitigate the influence of the future on their present. However, strategy is a two-sided coin: "On the one hand, strategy appears to be a scientific endeavor that provides theories, propositions, models and frameworks to master the future. The strategist is a technocrat who claims jurisdiction over the future (…) On the other hand, strategy is an engine of change, a mechanism to transform the present and mold it in the image of a desired future to come" (Kornberger, 2013, p. 104). By that, strategy is political – and powerful. If the strategist claims jurisdiction of the future, he or she is able to execute power. Actually, according to the classical work of Machiavelli, first published in 1532, strategy is the intentional execution of power (Machiavelli, 2001). Deception, he states, can be a legitimate means to reach the goal. Habermas (2000) would call this 'strategic action', which stands opposed to communicative action. Unlike communicative action, where a basis of mutually-recognised validity claims is presupposed, strategic action is goal-oriented and could be said to include manipulative features, which means that it has a somewhat dishonest intention that is not apparent to the receiver of the communication. Communication can thus be considered distorted (Habermas, 2000). By that, an ethical dimension is added to the concept of strategy.

Strategic communication as practiced across disciplines today is not limited to manipulation nor distorted communication in a purely negative sense. While morality is an essential part of human communication today, strategic communication can at the same time be understood as a method for persuading or convincing receivers to change. In our society today, we face strategic communication everywhere we go. The fight for people's attention is big, and it can sometimes be difficult to see the intention behind it. In a critical perspective, strategic communication can therefore be perceived as containing manipulative features. A more positive choice of words would be 'conscious communication'. The communication might even be so convincing that the receivers suddenly want to change, although they initially had no desire for it. Kornberger (2013, p. 105) calls this a "convincing performance of the future in the here-and-now".

Creating a 'convincing performance of the future' is, however, the research aim of this thesis. Exploring how scientific knowledge can be disseminated to

SMEs is to purposely (or consciously) attempt to create a change and improve SMEs' use of scientific knowledge. According to Falkheimer and Heide (2014, p. 10), a "fundamental starting point in strategic communication is that communication is not a simple tool for transmitting information and knowledge between people in an objectified world, but is the very means for producing and a resource that produces the social world". Accordingly, the objective of this thesis is a change, and in order to achieve this change (and direct it), the thesis will strategically launch different initiatives, which will be presented in Chapter 3. In examining, developing and evaluating a new generic pathway (which is a communication channel) for the dissemination of scientific knowledge to SMEs, the university seeks to change their communication and presentation of knowledge, thus attempting to make it more desirable to SMEs. In a negative framing, this could be called a manipulative feature: SMEs have not asked for this and they are (seemingly) doing fine without it. Why try and convince them into doing it? In a positive framing, the answer could be that communicating differently could create an awareness of the possible use of scientific knowledge, of an untapped potential, which SMEs could draw great benefits from, which in turn would be beneficial to society at large. However, it is interesting that the initiative for the improved communication comes from the university. Actually, according to Lynskey (2004), much of the impetus for closer university-industry links is driven not by enterprises but by universities. Understanding the dissemination of scientific knowledge as strategic communication then means to establish SMEs' potential incentives for engaging in a dissemination process. This could create a 'pull' for information (Bielak et al., 2008) from those who need it. It is part of the strategy of this thesis to build the communication up around the preferences of SMEs, thus diminishing the 'manipulation' and replacing it with 'motivation'.

2.2.4 MEDIUMS AND PATHWAYS FOR COMMUNICATION

As the discussion above illustrates, communication requires mediums (or channels). Just as communication can not only be done by humans (interpersonal communication), the mediums for communication are not limited to language or speech, although Habermas (2000) found language to be the medium to reach understanding and therefore ignored nonverbal actions and bodily expressions. However, nonverbal actions and bodily expressions such as gestures, body language, music, poetry, paintings, dance, signs, physical spaces, designs and so on *can* also be pathways of communication (mediated communication). A painting or a ballet, for instance, can convey a message, although it can be interpreted in more than one way, hence Habermas' dismissal of it as media for 'true' communicational actions. According to Oates (1964) the many media of communication poses 'the problem of the medium': Certain things can be communicated in certain media while certain things cannot. In order to achieve understanding, the medium must be carefully selected.

In a university-industry context, scientific knowledge can be disseminated numerous ways. Although researchers themselves for the most part continue to disseminate their findings in traditional ways (Cook, Cook, & Landrum, 2013), i.e. through journal articles or conference presentations, change is happening and more and more channels emerge. While patenting has also traditionally been considered the formal channel for transferring knowledge from university to industry (Agrawal, 2001), newer literature tends to focus on knowledge dissemination through collaborations, that is interpersonal communication (relational pathways) as opposed to through broadcast media, or mediated communication (generic pathways). Bruneel et al. (2010) call these two types of channels 'face-to-face interaction' and 'arm's-length interactions'. However, a basic understanding of relational pathways being more suited for this type of communication appears to be prevalent – and considered more modern. This comes across both implicitly, when publications that lists channels to knowledge dissemination mainly mention relational pathways (see for example Abbasnejad, Baerz, Rostamy, & Azar, 2011; Geuna & Muscio, 2009; Lock, 2010), or explicitly, for example when Cronholm and Sandell (1981, p. 92) write that "It has been well established that personal communication may be more effective than mass communication for certain purposes, and this might be particularly true about difficult topics such as scientific news".

However, what type of pathway is best suited for the dissemination of scientific knowledge should be based on considerations about what characterises scientific knowledge as a message. This is the essence of 'the problem of the medium' (Oates, 1964). In the context of the dissemination of scientific knowledge, the problem of the medium calls for considerations about what channels are best for disseminating the specific type of knowledge, which, in turn, calls for considerations about what type of knowledge scientific knowledge is. As argued in the first part of this chapter, this thesis explores the dissemination of explicit, encoded and demonstrative scientific knowledge, which requires generic pathways channels. However, that is not what is most common in this area of study. Rather, addressing the dissemination of tacit and embodied scientific knowledge is more prevalent. And because of this, a tendency to prefer relational pathways for the dissemination of scientific knowledge can clearly be identified. Consequently, an extensive amount of literature is prone to consider relational pathways (such as collaborative research, joint ventures, consultancy work, student placements or graduate employment, networks or shared facilities) as the preferred channel through which to disseminate scientific knowledge (Abbasnejad et al., 2011; Alexander & Childe, 2013; Ambos et al., 2008; Meyer-Krahmer & Schmoch, 1998; Monjon & Waelbroeck, 2003; Perkmann & Walsh, 2007). It appears to be a basic assumption in much existing literature within this area of study that if personal relations are *not* part of the dissemination process, and if the pathway is *not* relational, then the communication is automatically linear and does not allow for interaction and feedback. This is not true. Disseminating scientific knowledge through generic pathways does not equal linear or sender-oriented communication, nor should it be considered traditional. Using generic pathways, for example through digital media, is very relevant and contains a lot of possibilities (Bang & Dalsgaard, 2008). It might also be what SMEs request, which the analysis of my empirical data will indicate in Chapter 5. According to Iskanius, Niinikoski, Jokela and Muhos (2014, p. 97), "effective knowledge creation and sharing depend on an enabling context with physical, virtual, and mental aspects". This can be provided by relational and generic pathways alike. Generic pathways can be a consequence of an interactive communication process and furthermore they are potentially capable of offering interactive and dialogical communication where meaning is created by both communication partners. It is, however, true that it can be more challenging, which will be discussed again in Chapter 10, when the new generic pathway is presented.

While relational pathways might offer rich opportunities for knowledge dissemination, a downside to them is that they require high levels of co-ordination and sustained interaction. Generic pathways, on the other hand, rely on impersonal forms of dissemination and are thus less demanding for the involved parties. Disseminating scientific knowledge through generic pathways could potentially save time and resources for both university and industry (SMEs), although it will limit the disseminated knowledge to the scientific knowledge that has been codified. The latter is, however, not necessarily a problem. For example, Cohen, Nelson and Walsh (2002) find that published papers and reports are the most important channels through which universities can have an impact on industrial research and development. Bielak et al. (2008), however, state that effective science communication should include the full spectrum of approaches, from broadcast media to iterative dialogue. This indicates that multimodality is in fact the best procedure.

Because a common understanding in existing literature is that relational pathways. i.e. collaborative research, is the preferred way to disseminate scientific knowledge between university and industry, there is a lack of research exploring how it can be done through generic pathways. Accordingly, this thesis deliberately explores how it is done through generic pathways, which – within the limits of this thesis – requires scientific knowledge to be explicit, encoded and demonstrative. By that, this thesis will contribute to the research area by adding a focus on generic pathways as media for knowledge dissemination.

2.2.5 SUMMARY: DEFINING 'KNOWLEDGE DISSEMINATION' FOR THE PURPOSE OF THE THESIS

Reflecting on the concept of communication has helped to provide an understanding of what it means to 'disseminate' scientific knowledge. Dissemination is a type of communication, which means that the goal of it is to reach understanding and to make knowledge common. Furthermore, a dissemination process features the three basic constituent elements of communication: a sender (the university), a message (scientific knowledge and the dissemination hereof) and a receiver (the SMEs). Finally, I have shown that the dissemination of scientific knowledge can be understood as a strategic endeavour, because the university is purposely attempting to disseminate scientific knowledge in order to change the situation with an intended effect. By that, the work in this thesis can be understood as a strategic attempt to optimise the process of disseminating scientific knowledge to SMEs. Furthermore, this is done through a generic pathway as a medium/channel, which further separates the research conducted in this thesis from existing literature within the area of study.

Understanding knowledge dissemination as a communication process has implications for the research conducted in this thesis on more levels. First, it has methodological implications. Understanding dissemination as an *interactive* communication process means to regard the sender (the university) and the receivers (the SMEs) as equal partners. This entails that ongoing conversation with SMEs is prioritised and is a central way to generate knowledge in this thesis. By that, the development of a concrete generic pathway will be based on an interactive process, which is characteristic of the research logic of the thesis. As I will elaborate on in Chapter 3, the research conducted in this thesis can be classified as interpretive, because it is intensively focussed on the empirical world and aims at understanding the point of view of the beings (SMEs) living, acting and thinking within this social reality. Second, because this thesis will develop an actual communicational solution (a generic pathway for the dissemination of scientific knowledge to SMEs), understanding different perspectives on communication (transmission versus interaction) will allow for a consideration of what type of communication should be offered there. In other words, the communication offered *in* such a generic pathway can also be more or less interactive. This perspective will be discussed further in Chapter 10.

Drawing the parallel between dissemination and communication has allowed for an in-depth definition of knowledge dissemination and of the constituent parts in a dissemination process. Because knowledge cannot simply be taken from the generic pathway and put into SMEs, this thesis will explore what it takes to make the dissemination process successful. This includes asking questions such as: How can the message (scientific knowledge) be presented? How can it get from ‘sender’ (university) to ‘receiver’ (SMEs)? How can a generic pathway be used as a channel for this? What do SMEs need from this communication in order to find the message relevant? Answering these questions, this thesis seeks to explore and optimise the accessibility, relevance and use of existing scientific knowledge and to improve the overall contact between university and SMEs, which was the initial goal of the PhD project.

CHAPTER 3: RESEARCH DESIGN

In this chapter I will present the research design of the thesis. A research design, broadly conceived, refers to the basic structure of a research project and involves a clear focus of the research question, the purposes of the study, what information that will most appropriately answer specific questions, and which strategies are most effective for obtaining it (Denzin & Lincoln, 2000). The research design thus represents a structure that guides the philosophy of science and the execution of research methods, and it provides a framework for providing and analysing data (Bryman, 2012). While there are several different types of research design (Chenail, 2011), the one used by this thesis can rightfully be labelled as *exploratory* (Stebbins, 2001). An explorative research design is appropriate when little or no scientific knowledge about the social phenomenon is possessed. As illustrated throughout Chapter 1 and Chapter 2, this is accurate for the dissemination of existing scientific knowledge to SMEs through generic pathways. To explore a social phenomenon effectively, researchers must be flexible in looking for data and open-minded about where to find it (Stebbins, 2008). As I will elaborate on in the following, flexibility and open-mindedness are primary aspects of the research logic in the thesis.

While the research conducted in this thesis can be labelled explorative, it is also change-oriented. As mentioned in Section 1.6, a notion of *optimisation* resides in the research aim. In asking *how* scientific knowledge can be disseminated to SMEs using generic pathways, the goal is not only to examine how it is done at present, but also to explore how it can be done in the future. Accordingly, a research design that allows for such exploration must be created. Based on a thorough examination of existing knowledge and an examination of the current situation (what is already known, what works, what barriers exist and what do SMEs need from a dissemination solution), the thesis will develop and evaluate an actual generic pathway that exemplifies and concretises the explorative aim of the thesis. Accordingly, the thesis' research design consists of three phases.

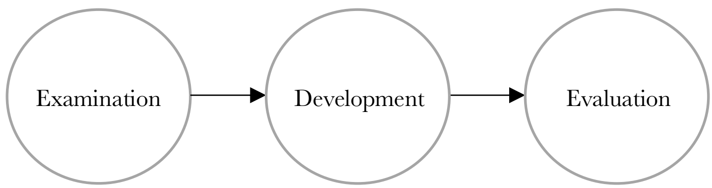

Figure 3.1. Three phases of the thesis

All three phases have a purpose related to answering the research question. Each phase targets different sub-questions and, therefore, contains different studies on literature and social practice. Collectively, the research efforts of the three phases will provide an answer for the research question. Figure 3.2 summarises the connection between phases, sub-questions and studies.

It is characteristic to the research conducted in this thesis that it is predominantly (but not solely) qualitative in its aim and approach. According to Dahler-Larsen (2008, p. 24), qualitative research is defined in terms of its methods, which can be approached on at least three different levels:

- Method as philosophy of science: epistemology and ontology
- Method as logic of inquiry
- Method as technique and tool for treating and applying data.

The higher level consists of considerations about the philosophy of science, which refers to what is regarded as acceptable and valid knowledge within a discipline. The lower level is the technical level where considerations about the specific research methods being used take place. The methods are used to carry out the research design and its logic and might be thought of as 'applied philosophy' (Schwartz-Shea & Yanow, 2012). The middle level is the level of research logic.

In the following, the three methodological levels mentioned above will serve as a structure to present the different aspects of the research design. I will begin in the middle by addressing the research logic in order to present the fundamental logic of inquiry in this thesis. Of course, the three levels must reflect each other and be coherent with the research question. The research question is the guiding principle for all methodological considerations, and thus, the research design is a direct result of the research question, and it guides the execution of the research methods used, the data created, the analysis conducted and the conclusions made. Accordingly, the goal of this chapter is to provide a thorough presentation of how an answer to the research question will be attained.

3.1 THE RESEARCH LOGIC OF THE THESIS

According to Bryman (2012), studying the social world requires a different logic of the research procedure than that of natural sciences. The subject matter of the social sciences requires the researcher to be able to grasp the subjective meaning of social action. As already stated, this thesis is characterised by being predominantly qualitative in its aim and approach. The research logic of qualitative research is to avoid predeterminations and allow categories of

	Phase	Sub-question	Study
Exploration	Examination	SQ1: What problems and solutions are known and addressed in relation to the dissemination of scientific knowledge to SMEs?	A: Literature Study
		SQ2: What characterises the situation of SMEs and their relation to (scientific) knowledge?	B: Studying the situation of SMEs in relation to (scientific) knowledge
		SQ3: What are the communicative principles for the dissemination of scientific knowledge to SMEs?	
		SQ4: How is existing scientific knowledge presented and organised in a Research Information Management System (a generic pathway, and how does it correlate with the requirements of SMEs?	C: Studying a Research Information Management System
	Development	SQ4: How can a generic pathway disseminate scientific knowledge based on an understanding of the situation and preferences of SMEs?	D: Workshop Study
			E: Usability Study
	Evaluation	SQ5: To what extent does the generic pathway that is based on an understanding of the situation and preferences of SMEs optimise the dissemination of scientific knowledge to SMEs?	F: Evaluation Study

Figure 3.2. Overview of the research design

inquiry to be determined by the actors and the situation and are thus developed as a function of the actual research undertaken (Dahler-Larsen, 2008). Because of that, qualitative research operates with a flexible design and an open-mindedness regarding methods and data appropriation. When the researcher takes on a position from outside the social context being studied, he or she may come up with findings that appear surprising. If and when that happens, open-mindedness and a flexible design is required in order to keep pursuing the research aim. Thus, flexibility is a condition of qualitative research.

A research logic characterised by avoidance of predeterminations, value of situatedness, and flexibility regarding research methods echoes the inductive approach (Fox, 2008). In inductive reasoning, particularities are used to propose broad understandings of generalities. Induction lies behind any effort to generate general statements based on empirical data. In scientific research, induction is a form of reasoning used to pursue understanding and knowledge, establishing a relationship between observations and theory. Inductive approaches value exploration and understanding of social practices through subjective perspectives. On an ontological note, social entities are not considered objective within this research. Rather they are social constructions built up from the perceptions and actions of social actors (Bryman, 2012), which, as I will show, reflects the epistemology of the thesis.

However, while the overall research logic of the thesis can rightly be labelled inductive, it cannot be limited to this. While it is commonly accepted that the inductive work process is characteristic of qualitative research, this does not mean that qualitative research cannot involve deductive practices – which is also widely acknowledged. Accordingly, the research of this thesis is not solely inductive. Rather, the approaches taken change according to stage and study in the research process. Because the different studies of the thesis aim at answering different sub-questions where different types of insights are required, I argue in favour of using a range of research methods that include both inductive and deductive logics a well as qualitative and quantitative logics. This will be elaborated on in connection with the technical level, where the research methods of the individual studies of the thesis will be presented.

3.2 THE PHILOSOPHY OF SCIENCE CLAIMED BY THE THESIS

Determining the philosophy of science means to make epistemological considerations about the guiding paradigms (Schensul, 2008) of the research. An epistemological issue concerns the question of what is (or should be) regarded as acceptable knowledge in a discipline (Bryman, 2012). This means to consider what principles and procedures the social world should be studied according to. Chua (1986) classifies research epistemologies into positivist, interpretive and critical. Qualitative research can be done from any of these three stances (Klein & Myers, 1999).

The research epistemology of this thesis is heavily influenced by interpretivism. Interpretive research is a framework and practice within social science research that is invested in philosophical and methodological ways of understanding social reality (Bhattacharya, 2008). The notion of '*Verstehen*' (first discussed by Max Weber) and the concept of 'meaning' are central to the interpretative framework. In the understanding of social reality, meaning-making is the primary goal. Focus is on the specific, situated meanings and meaning-making practices of actors in a given context (Schwartz-Shea & Yanow, 2012). Reality has a meaning for human beings and therefore human (social) action is inherently meaningful (Schwandt, 2000). To understand a particular social action, of which dissemination of scientific knowledge is an example, the meanings that constitute that action must be understood. Accordingly, understanding social action requires a complex set of tools and includes an understanding of the point of view of the subjects of the study (Harper, 1992). For that reason, interpretive research has an intensive focus on the empirical world. Social reality and social phenomena has a specific meaning and relevance structure for the beings living, acting and thinking with it (Schutz, 1962). Understanding behaviour in its particular and situated forms is central. Thus, interpretivist approaches believe that it is the job of the researcher to gain access to people's 'common-sense thinking' and to interpret their actions and their social world from their point of view. The research conducted in this thesis can be classified as interpretive because it is assumed that knowledge about reality is gained through "social constructions such a language, consciousness, shared meanings, documents, tools, and other artefacts" (Klein & Myers, 1999, p. 69). This will be reflected in the choice of research methods, which I will get back to when reflecting on the technical level later in this chapter.

Gaining access to people's common-sense thinking is done by empirically accessing their specific and situated meaning-making practices. In doing that, data is created (not collected). Because interpretive researchers see the research world and the researcher as entwined, data is created through the framing of a research question and the actions in the research design that act hereon. In this perspective, data is not 'given' as it has no prior ontological existence as data outside the framework of a research project (Schwartz-Shea & Yanow, 2012).

3.2.1 VALIDITY AND GENERALISABILITY OF RESULTS

Researchers from positivistic traditions often ask whether research results are generalisable. While qualitative research *can* be generalised (Lewis & Ritchie, 2003), interpretive methodologists dispute the usefulness (and desirability) of knowledge that claims to 'rise above' its situatedness (Schwartz-Shea & Yanow, 2012). In interpretive understandings, social phenomena are dynamic and fluid and, accordingly, interpretive researchers do not predefine dependent and independent variables, but focus on the complexity of human sense-making as the situation emerges (Klein & Myers, 1999). Unlike the positivistic epistemology, interpretive researchers take an ideographic stance by believing that people and organisations are not fixed, but rather are constantly changing. The orientation toward knowledge in interpretive research is focussed on meaning-making and contextuality (rather than generalisability). According to Schwartz-Shea and Yanow (2012), the standards of validity, reliability and replicability are ill-suited to interpretive research because they do not account for the (in)stability of the social world and researchers' methods of learning about it. However, the problem of induction (Fox, 2008) applies to interpretive research: the outcome of inductive reasoning is never binding, given that a contradictory case may always overturn the generalisation.

According to Williams (2000), interpretive researchers do generalise in a form he calls 'moderatum generalisation', which refers to inferring aspects from a specific instance to a broader recognisable set of features. This must, however, be closely tied to the context, and general theory-building is not the aim. This does not mean that interpretive researchers do not theorise. Rather, theorising in interpretive research is done on the basis of knowledge that makes clear its connections to specific human beings in specific settings. Research has to be contextualised and its situatedness must be demonstrated.

This ontological understanding of what knowledge is echoes postmodern perspectives, where all knowledge is seen as socially and culturally produced (Clarke, 2005). Knowledge is understood as 'situated', which means it is produced and consumed by particular groups of people that are historically and geographically locatable. As a consequence, objective and neutral descriptions are not possible and, accordingly, no 'one true meaning' is produced in an interpretive study. In postmodernism, it is dismissed that any one method or theory has a universal claim of what is the 'right' knowledge. This does not mean that conventional methods of knowing are rejected. Rather, it calls for new and flexible methods that can be subjected to critique. This has implications for the way knowledge is accumulated. Knowledge is a social construct, a product of shared beliefs and interpretive practices, inextricably linked to social context. Meaning-making is individual and the creation, acceptance, rejection and reinterpretation of knowledge is intersubjective (Olsson, 2008). As a consequence, generating the knowledge required by the thesis' research question is done only by understanding how SMEs (as a group) socially produce and consume knowledge. Gaining access to SMEs' 'common-sense thinking' in relations to scientific knowledge and dissemination thereof is evident. What meaning and relevance do they ascribe to scientific knowledge and the dissemination thereof? Acquiring such intersubjective understandings in all three phases of the thesis (Figure 3.1) will be prioritised.

3.2.2 RESEARCHER SENSE-MAKING

In interpretive research, it is recognised that the researcher is inevitably embedded in the social processes of the world they study. In positivistic research, a standard for assessing a research study is 'replicability'. Replicability concerns the question of whether the same research project, from data creation to analysis, would, if carried out by another researcher, produce the same results. However, in interpretivist research, researchers are, as well as participants, 'embodied' or situated and play a role in data creation. The researcher is the 'research instrument' and, accordingly, researcher characteristics will inevitably influence the research process. For this reason, checking my own meaning-making is a necessary scientific step in the research of an interpretive character. As a consequence, the interpretivist paradigm sees different interpretations as inevitable. Disembodied research is not an option in this perspective. Researchers cannot conduct interpretive research without interacting with situational participants and without having those interactions affect their interpretations and knowledge generation. "There is no place to stand outside the social world that allows a view of truth unmediated by human language and embeddedness in circumstance" (Schwartz-Shea & Yanow, 2012, p. 98).

Accordingly, checking researcher sense-making is important. Being reflexive about this means to consider the ways in which my own sense-making relates to the knowledge claims (Schwartz-Shea & Yanow, 2012). How do my characteristics matter and how does my scholarly community impact the research endeavour? This means checking my interpretations with participants and being aware of my own pre-understandings and their origin. In the thesis, these will continually be explicated, when they have an influence on the decisions being made.

3.2.3 INTERPRETATIVE PHENOMENOLOGY

Within interpretivism as a social epistemology, different intellectual traditions or approaches exist. Understanding human behaviour – which is a key ingredient in all social sciences – from a subjective point of view, is the particular feature that phenomenologists have typically emphasised. Phenomenology is a philosophy that is concerned with the question of how individuals make sense of the world around them (Bryman, 2012). In order to grasp the meanings of a person's behaviour, "the phenomenologist attempts to see things from that person's point of view" (Bogdan & Taylor, 1975, p. 13). Phenomenology is thus a way of making sense of interpretive understanding (Schwandt, 2000).

The concept of 'lifeworld', first introduced by Husserl in 1936, expresses the idea that individuals' realities are invariably influenced by the world they live in. Accordingly, phenomenology focusses on the meaning-making that takes place in the lifeworld of the individual and in groups. "Everyday life is understood to consist of common sense, taken for granted, unspoken, yet widely shared and tacitly known "rules" for acting and interacting, the articulation of which constitutes one of the central concerns of phenomenological analysis" (Schwartz-Shea & Yanow, 2012, p. 42).

The phenomenological tradition, and especially that of interpretive phenomenology, also gives some pointers as to how I should understand and access my own meaning-making. Characteristic to interpretive phenomenology (as opposed to descriptive phenomenology) is the understanding that it is impossible to rid the mind of its background of understandings (Lopez & Willis, 2004). Phenomenologically, a researcher always brings his or her prior knowledge (based on experience and on personal, educational and other backgrounds to a setting). As a researcher in an area of study, I am embedded in that social reality and it is my challenge to estrange myself "sufficiently from that unspoken, intersubjective common sense to render it "uncommon", reflect on it, and make sense of it" (Schwartz-Shea & Yanow, 2012, p. 42). However, seeing is always partial, and since I cannot free myself of my embeddedness, I can strive to make myself aware of it, i.e. by explicating assumptions and predeterminations. Further, I must seek to ascertain and explore an area of study on the premises of the human agents constructing it. It is the concepts, language, contextual knowledge and (social) meaning-making of the human agents in an area of study that must be explored.

This approach to accessing meaning and to interpreting my own and others' actions as meaningful is adopted in central parts of this thesis. Note that this thesis does not claim phenomenology, rather parts of interpretive phenomenology serve as inspiration for the methodology of the thesis. For example, when exploring the situation of SMEs (Study B), asking questions that allow respondents to describe their lifeworld will be prioritised, which is thus a way to access their (social) meaning-making.

3.2.4 ACTING ON RESEARCH

By introducing 'development' and 'change-orientation' as goals of the thesis, an important focus is revealed. The goal of this research is not solely of an interpretive character, because the research is not finished when understandings and interpretations of the current situation are acquired. As already mentioned, the exploratory nature of the research question also prepares the ground for taking action upon the research results and exploring a change. Interpretivists see action on research results as a meaningful and important outcome of inquiry processes (Lincoln & Guba, 2000). The Development phase is oriented towards an external social transformation (as opposed to an internal transformation). It means that it is not the SMEs themselves I seek to change, rather it is their use of generic pathways (and the pathways themselves) that must be changed and improved, based upon interpretive understandings of SMEs' social reality. In other words, it is the *dissemination* of (physical) knowledge this thesis will examine and not how the receivers understand and transform the knowledge, as also mentioned in Section 2.1. However, one could argue that by attempting an external transformation, an indirect internal transformation of SMEs might also take place.

Central to the thesis is that the acting on research will be based on SMEs' meaning-making, which is also related to the emphasis on SMEs and universities being equal partners in the communication process (see Section 2.2.5). SMEs will be invited to join the knowledge-creation process in all three phases of the thesis. Exploring and providing insights about the former, present and future needs of SMEs (Sanders, 2005) followed by a transformation of these into theories and solutions will be a central part of the thesis' contribution. This correlates with interpretivism: Including SMEs in the processes is a way to ensure continued access to the meaning-making of SMEs and it indicates that this thesis values collaborative, empirical and context-dependent knowledge. It will not be the university or existing theory that dictate future insights and solutions, which echoes the inductive logic of the thesis.

3.3 THE RESEARCH METHODS USED IN THE THESIS

Within the overall methodological framework, several different studies involving various research methods are conducted. I have composited the studies from an understanding of the research question and what knowledge is needed in order to answer it. The research design bears witness to an open-minded process of acquiring and interpreting understandings, especially from the point of view of the subjects of the study. With the exception of Study A, which is a meta-study, all the studies in the thesis involve empirical understandings of SMEs' common-sense thinking related to the dissemination of scientific knowledge.

All six studies of the thesis have exploratory ambitions and are conducted in order to provide knowledge on the area of study. While Study A is a meta-study aimed at examining the existing literature within the area of study, the remaining studies are primary research studies, where new data is created and analysed. Valid for the three studies of the Exploration phase is that they will help to explore the basic patterns of dissemination of scientific knowledge to SMEs, which is the phenomenon in study. Study B especially aims at exploring the situated meanings and meaning-making practices of actors in SMEs. Working with participants from SMEs to create a change, the Development phase explores how action can be taken on the research results. The Evaluation phase explores SMEs' attitudes towards the interface. Collectively, an answer to the research question is provided.

In the following, I will present what I have done and why these choices make sense in the context of my thesis. I will reflect on the purposes and research procedures for each of the six individual studies, and I will clarify my decisions about research methods, sampling strategies and the ways I have created, processed and analysed data.

3.3.1 STUDY A: LITERATURE STUDY

One of the first steps of the thesis is to construct a foundation on which further research can be built. In interpretive research, a literature study is used to develop the researcher's prior knowledge about the issues that inform the research question, as well as about the setting in which the research will be carried out (Schwartz-Shea & Yanow, 2012). Conducting a literature review will do this. A literature review (1) sets the broad context of the study, (2) situates existing literature in a broader scholarly and historical context and (3) demarcates what is and what is not within the scope of the investigation, and justifies these decisions (Boote & Beile, 2005).

The area of study in this thesis is composed of two subjects not commonly examined together: (1) the dissemination of scientific knowledge, and (2) the dissemination of knowledge between university and SMEs in particular. A literature review allows me to distinguish what has already been addressed and accomplished in this composited area of study and what still needs to be learned. However, literature reviews on the dissemination of scientific knowledge to SMEs specifically are scarce. Throughout the PhD project I have not managed to find a review with this specific focus. While Agrawal (2001) conducted the most thorough literature review on university-to-industry knowledge transfer I have come across, it does not mention SMEs even a single time. Accordingly, in Study A I will conduct a review where SMEs make up a central factor. It is of relevance not only to this thesis but to the research area in general. A goal of the Literature Study is to find diverse examples on how scientific knowledge can be disseminated to SMEs and to see what experiences I can learn from. This is of great value to the remaining studies of the thesis. Thus, exploring the state of art of this relatively unexplored combination of study areas will provide a theoretical classification of central aspects within the area – and examples and experiences to learn from. That sums up the first sub-question (SQ1), which is the specific question the Literature Study seeks to answer: What problems and solutions are known and addressed in relation to the dissemination of scientific knowledge to SMEs?

The Literature Study will be done as a systematic review (Cronin, Ryan, & Coughlan, 2008). A systematic review is a study that seeks to answer a clearly formulated question by finding, describing and evaluating evidence from published research on topic(s) related to that question within a specific set of boundaries of existing and relevant publications (Eriksson, 2014). However, the notion of what publications are 'relevant' demands attention. Setting boundaries and defining what is relevant means to define some goals for the review, which must stem from the research question of the thesis (see Section 1.6). To answer the research question, answering the sub-question is essential. This requires an understanding of what activities within knowledge dissemination between university and SMEs take place today as well as understanding what problems exist and dominate the process. Accordingly, the goal of the literature review is to create a foundation for answering the research question by structuring an overview (1) of the literature within the area of study and (2) of the barriers and solutions to successful dissemination of scientific knowledge. This will also help to unmask what needs to be further addressed in later studies of the thesis. Note that the goal of the review is not to study methods and theories used to examine knowledge dissemination as a social phenomenon, nor is it to reveal the historical evolvement in knowledge dissemination. Rather, the goal is to create a defined group of examples that illustrate how knowledge dissemination works and does not work.

The systematic review will be structured in four phases. These phases are inspired by Cronin et al. (2008) and by Randolph (2009), who each present a structure for conducting such a review. Their structures are different but comparable. For example, where Cronin et al. (2008) have one phase of 'gathering, reading and analysing the literature', Randolph (2009) divides this into two phases by separating data evaluation from analysis and interpretation. Combining their structures, the structure in this study will be as follows:

1. Determining the goal(s) of the review
2. Searching for and selecting publications
3. Analysing the data
4. Writing the review

Note that with this review my aim is not to make an exhaustive description of existing literature in the field, but rather to conduct a focussed and goal-oriented search that will provide insights relevant to the answer of the research question. This introduces the problem of 'coverage' (Boote & Beile, 2005; Bruce, 2001; Cooper, 1988). Coverage has to do with how reviewers search for literature and how they make decisions about the suitability and quality of materials. Bruce (2001) suggests incorporating a broader and more flexible understanding of the question about coverage, concerned not only with the *breadth* of the coverage but also with making it *reflected* and *applicable*. To do this, some screening criteria will be outlined. The purpose of these is to make the decisions about what is relevant more specific and valid. The screening criteria stem from the research question of the thesis and from the recently-defined goals of the review. I am choosing publications that

1. Analyse problems or barriers to the dissemination of knowledge between knowledge institution and firm, and/or
2. Outline designs and/or models for the dissemination of knowledge between knowledge institution and enterprise, and/or
3. Pass on experiences on the dissemination of knowledge between knowledge institution and enterprise.

The process of finding and selecting publications is a central part of a systematic literature review. Accordingly, descriptions and reflections hereof will be presented prior to the review itself in Chapter 4.

3.3.2 STUDY B: STUDYING THE SITUATION OF SMEs IN RELATION TO (SCIENTIFIC) KNOWLEDGE

When the literature review has generated understandings of existing knowledge within the area of study, it will be profitable to supplement them with empirical insights. According to Schwartz-Shea and Yanow (2012), both theoretical literature and empirical material is necessary in interpretive research, but neither is sufficient on its own. Accordingly, Study B will supplement and elaborate on Study A's theoretical understandings with empirical perspectives. Because the research epistemology of this thesis is interpretive, it is essential to understand the area of study from SMEs' point of view in order to explore how existing scientific knowledge can be disseminated to SMEs using generic pathways and thereby provide an answer to the research question. Identifying the characteristics of SMEs' situations and their relation to (scientific) knowledge (SQ2) is a central part of this thesis' process to answer the research question.

A few existing studies are worth mentioning. In a couple of papers, (de Zubielqui et al., 2015; de Zubielqui et al., 2016) researchers examine how and why SMEs access knowledge from external actors in general and from higher education institutions in particular and how such external knowledge inflows from external actors influence the SMEs. These studies are of great relevance to this thesis and will be mentioned again. They are, however, some of the few empirical studies that focus on SMEs in this context. While they use a survey as a research method to conduct a primarily quantitative study on Australian SMEs, the methodology of this study is more qualitative and explorative.

The purpose of Study B is to explore characteristics of SMEs' situation in relation to (scientific) knowledge. To do this, a study on what I call 'the situation of SMEs' is conducted. By 'situation', I refer to the circumstances, history, needs, attitudes, shared meanings, procedures and traditions of SMEs, primarily in relation to knowledge work. In order to study the situation of SMEs, I need to gain access to the common-sense thinking of SMEs and to interpret their actions and understandings from their point of view. An important ontological question, then, is how do I access SMEs and their common-sense thinking? An SME is not an individual with a subjective social meaning to express. Rather, SMEs are organisations, and – without going into the field of organisational theory – organisations are social units of people that are structured to pursue a collective goal. As Nonaka (1994) stated, an organisation cannot create knowledge without individuals. Accordingly, I must explore the knowledge-creation and the meaning and relevance structure for the individuals living, acting and thinking within the SME. By that, to understand an SME means to understand its social voice, which can be accessed through creating and analysing individual-centred material, i.e. interviews with individual employees or observations of practices, artefacts and physical arrangements.

Thus, Study B is an exploratory and inductive examination of the situation of SMEs. The study uses a variety of different qualitative research methods and its focus on situations and overall philosophy is inspired by that of situational analysis (Clarke, 2005). Situational analysis is a regeneration of Grounded Theory, which is an epistemologically sound approach to qualitative research. According to Clarke (2005), situational analysis is a new and more postmodern approach to analysis within the grounded theory framework. That means that it emphasises complexities (partialities, positions, heterogeneities, situatedness, and fragmentation) (Clarke, 2005). In situational analysis, the 'basic social process' concept (that is, the conceptual infrastructure of grounded theory) is replaced with the situation-centred 'social worlds/arenas/negotiation' framework. The goal of situational analysis is to analyse complex situations of inquiry broadly conceived. In situational analysis, the situation per se becomes the ultimate unit of analysis, and understanding elements and their relations is the primary goal. Thus, it is the job of the researcher to construct the situation of inquiry, which is done by mapping the data. For this, situational analysis offers cartographic approaches that centre on elucidating the key elements, materialities, discourses, structures, and conditions that characterise the situation of inquiry.

Methodologically, situational analysis is in line with the philosophy of science of this thesis, in that it gains knowledge about the social reality of SMEs through the study of their social constructions such as language, consciousness, shared meanings, documents, tools, and other artefacts. Situational analysis engages analysis of individual-centred materials, by which its roots in interpretivism show. However, situational analysis is deeply committed to 'situation interpretation', seeing as it is the full situation of inquiry that is addressed and analysed. The outcomes of situational analysis should be 'thick analyses', which parallels Geertz's (1973) 'thick descriptions'. Thick analyses take explicitly into account the full array of elements in the situation and explicate their interrelations.

While Study B is inspired by situational analysis, it is not a situational analysis per se. It does not strictly follow the methods outlined, it does not use the cartographic approaches, the situation per se is not the ultimate unit of its analysis, and the study will not result in a 'thick analysis'. For these reasons, I consistently refer to it as a study of the situation of SMEs rather than a situational analysis. Instead, the goal of Study B is to understand the situation of SMEs related to knowledge: what needs, attitudes, shared meanings and procedures exist with this group related to knowledge work? How do they work, collaborate and organise themselves? What materials and artefacts are available to them? What sources of knowledge do they prefer and why? What is their understanding and use of the university and scientific knowledge? These understandings will be provided by displaying a range of factors that influence and determine the situation of SMEs. By that, the philosophy of situational analysis regarding the type of insights needed has inspired the foundation of this study. The central focus on interpreting a situation by elucidating its key elements, materialities, discourses, structures, and conditions is adopted, the goal being to make clear what circumstances dissemination of scientific knowledge should take into account in order to be successful. The outcome of Study B will be an in-depth thematic analysis of SMEs' situation in relation to knowledge. In the following, I will present and motivate the individual research methods used in the study.

3.3.2.1 Case studies

In this study, SMEs are the unit of analysis and, accordingly, a number of individual SMEs will constitute a number of cases. However, the status of a case can be questioned. A case may be simple or complex. It may be a country, a community, an organisation or a person. A case might be an SME or an individual employee in that SME. What is regarded as a case affects the conduct and results of the research. As already mentioned, I consider an SME to be a case in the context of this study, and I therefore consider a case to be a specific empirical unit, 'out there' ready to be discovered and examined (Ragin, 1992). However, as discussed earlier, in order to understand an SME, the point of view of the individual employees will form the basis for understanding the shared points of view of the group to which the subject (the SME) belongs (Harper, 1992). In other words: The individual voices will provide access to the social voice (Clarke, 2005). By that, the individual employees are 'cases within the case' (Stake, 2000).

A case study is a choice of *what* to study, not *how* to study it (Stake, 2000). Accordingly, Study B uses different qualitative research methods to create different types of data in order to study cases of SMEs. On a methodological note, a case study is an ideographic approach, producing content-dependent knowledge and being concerned with elucidating the unique features of a specific case (Bryman, 2012). According to Flyvbjerg (2006), it is incorrect to conclude that generalisations cannot be made from studying a single case. Context-dependent knowledge and experience are at the very heart of expert activity, he states. That knowledge cannot be formally generalised does not mean that it cannot enter into the collective process of knowledge accumulation in a given area of study. Instead, he suggests that one can often generalise on the basis of a single case, and the case study may be central to scientific development via generalisation as a supplement or alternative to other methods. It all depends on the case and how it is chosen. Accordingly, strategic sampling of cases is necessary, which I will get back to. However, generalisation is not automatically the goal. As pointed out by Stake (2000), damage occurs when the commitment to generalise overpowers the commitment to understand the case itself. When understanding a case is the first and last interest of a study, it can be termed an 'intrinsic case study' (Stake, 2000). In an intrinsic case study, it is the case itself that is of interest, in all its particularity and ordinariness. However, in this study, the first and last goal is not to understand one case. Rather, I aim at understanding more cases in order to understand the circumstances of SMEs and their relation to (scientific) knowledge more broadly perceived. To do this, I include not just one SME but a range of SMEs in the study. By that, this study takes the form of a multiple-case study approach (Bryman, 2012) where more cases are examined and compared using identical methods. Accordingly, the case studies of Study B are of an instrumental rather than an intrinsic character, seeing as they pursue an external interest (Stake, 2000), which is to answer the research question of the thesis. Conducting a multiple-case study as opposed to a single-case study will allow for patterns of common and differentiating factors to be indicated (homogeneities and heterogeneities), which can initiate a discussion on whether findings from the specific studies can be said to also apply to SMEs more broadly perceived. By that, I seek to make possible a 'moderatum' generalisation (Williams, 2000). Naturally, although including more SMEs in the study, the insights about their situation related to (scientific) knowledge will not be exhaustive. The goal is to explore a variety of SMEs, thus examining the limits of the SME definition (Table 1.1), in order to find a number of cases that illustrate both heterogeneities and homogeneities of SMEs' conditions and circumstances. In conclusion, this study will not consist of in-depth case studies but of a cross-case thematic analysis of the different types of data created during the exploration of the individual cases. With this approach, I aim at understanding SMEs as broadly perceived, which will be the foundation for exploring the 'general' phenomena of the dissemination of scientific knowledge to SMEs.

Because I aim at exploring SMEs as they are broadly perceived, I am not looking for unique or extreme cases. Rather, I seek to select 'representative' or 'typical' cases, because my objective is to "capture the circumstances and conditions of an everyday or commonplace situation" (Yin, 2009, p. 48). Flyvbjerg (2006) states that this may not be the most appropriate strategy, because the typical or average case is often not the richest in information. However, I need to understand what is typical for the situation of SMEs, which is my reason for conducting case studies. Finding SMEs that are expected to somewhat represent a population of cases will be an advantage. That being said, I have no sense of what an 'extreme SME' is in this relation. My point of stating this is to clarify my intention when it comes to selecting SMEs. I aim at selecting SMEs that – in some aspects, at least – are typical and exemplify a broader category of SMEs. An SME chosen for the study might turn out to be extreme, even though first rendered typical. I may not understand the nature and significance of a case until I have subjected it to detailed scrutiny. Consequently, it is a sub-goal of the case studies to visualise what might be typical for SMEs and what might be more extreme.

3.3.2.1.1 Selecting a sample of cases

Eight SMEs with different characteristics (size, age, trade, location) have formed the basis of eight case studies. How the specific sample of SMEs were selected will be discussed in the following.

I have conducted what Flyvbjerg (2006) labels an 'information-oriented selection', which stands opposed to a random selection. In an information-oriented selection, cases are selected on the basis of expectations about their information content. This is also what is commonly labelled a 'purposeful sample' (Patton, 1990) or 'purposive sample' (Bryman, 2012), where information-rich cases are strategically selected for in-depth studies. According to Bryman (2012), selecting cases on the basis of their appropriateness to the purpose of the research can be as valid a sampling principle as basing it on the idea of representativeness. Stake (2000) notes that instrumental casework requires researchers to choose their cases, and choose them well, based on a thorough understanding of the area of study, which is exactly the point of a purposeful sample. In this thesis, it is relevant to conduct case studies on SMEs (from Northern Jutland in Denmark, see Section 1.6), as their perspectives are central to understand in order to answer the research question and respect the given terms of the PhD project. Even though SMEs are a specific type of enterprise where some commonalities occur, the definition still covers a wide array of enterprises with many varying characteristics. First, the size of an SME matters. Covering micro, small and medium-sized enterprises, the conditions and situations of SMEs vary immensely. The behaviour of micro firms may differ from that of small firms, which may also differ from medium-sized firms. Freel (2006) found that a firm's size was positively associated with innovativeness, and de Zubielqui et al. (2015) found that smaller firms are less innovative than their larger counterparts. Furthermore, they found that important differences between micro, small and medium enterprises exist, especially in terms of understanding how they collaborate to access knowledge to innovate. Note that I address size according to number of employees and not based on turnover, the reason being that Danish enterprises are not obligated to report on turnovers. Second, other characteristics are assumed to influence the situation of an SME. For example, I assume that variations in procedures and traditions will differ according to trade, and that SMEs employing mainly academics will have a different attitude towards scientific knowledge than SMEs employing mainly unskilled workers. These assumptions influence the sampling process. In order to capture all these variations, I conduct a 'maximum variety sample' (Sandelowski, 1995), where the aim is to include SMEs with as wide a variation as possible in terms of selected characteristics. While there are different kind(s) of variations, i.e. demographic, phenomenal or theoretic (Sandelowski, 1995), I used three demographic variation criteria for selecting SMEs for the study: size, type of knowledge-intensive service and geographical location.

I decided to limit SMEs to knowledge-intensive enterprises (Alvesson, 1993; Blackler, 1995); see Section 2.1.2 for a definition. In the simplest sense, this covers enterprises trading knowledge rather than physical products. It means enterprises who work on developing, selling or communicating knowledge and to whom knowledge is interesting and relevant. Such enterprises can help provide insights on how scientific knowledge should be disseminated in order to appear interesting and relevant. For the practical distinction regarding trades, I use Eurostat's definition of knowledge-intensive services, which covers: (1) High-tech knowledge-intensive services, (2) Knowledge-intensive market services, (3) Knowledge-intensive financial services and (4) Other knowledge-intensive services (Eurostat, n.d.).

In order to capture variations in size, I found it profitable to include two SMEs of different sizes from each of the four groups of knowledge-intensive firms. That gave me a total of eight different SMEs. I aimed at finding SMEs from different parts of Northern Jutland. All of this being said, the final choice of SMEs was a mix of what was purposive and what was convenient. I quickly discovered that SMEs are not an easy target group to involve in a research project. They are busy and short on time for purposes other than their primary conduct of business. As an example, I contacted more than 20 SMEs with invitations to participate in the study. The contact was mostly via e-mail, sometimes via telephone. I would find the right person to talk to in the enterprise, give them a short introduction to the research project and explain what would be required of them as participants.

Several SMEs declined to participate, a common reason being that they lacked the time and resources for it. However, eight SMEs agreed to partake in the study. Each of these constitute a case. In Table 3.1, the characteristics and the variation factors of each of the SMEs are illustrated.

Taking a critical look at this list, it has its strengths and weaknesses. While the variation regarding size (number of employees) is spread across micro, small and medium-sized SMEs, the geographical location is not. Eighty percent of the SMEs are located in Aalborg, which means that they are geographically very close to the university. While this over-representation is somewhat acceptable seeing as Aalborg municipality is by far the largest of all the municipalities in Northern Jutland and accordingly houses more enterprises, it does have the impact that these enterprises are potentially more used to 'meeting' the university in the townscape. As I will address in Chapter 4, previous studies

Enterprise Name	Subject	Number of employees	Age	Location	Type of knowledge-intensive service
Studiecykel.dk	Marketing and sustainability	2	1 year	Aalborg	(2) Aalborg Knowledge-intensive market services
Bjørk & Maigård ApS	Architecture and design office	11	19 years	Aalborg	(2) Knowledge-intensive market services
konXion	Social media	15	5 years	Aalborg	(2) Knowledge-intensive market services
Clienti	Advertising and counselling	25	3 years	Aalborg	(2) Knowledge-intensive market services
Musikkens Hus	Concerts and cultural activities	150	1 years	Aalborg	(4) Other knowledge-intensive services
RTX	Engineering and technology development	165	21 years	Nørre-sundby	(1) High-tech knowledge-intensive services
Neas Energy	Energy production and energy trade	220	16 years	Aalborg	(1) High-tech knowledge-intensive services
Nordjyske Bank	Banking and financing	250	100+ years	Sæby	(3) Knowledge-intensive financial services

Table 3.1. Overview of cases and their characteristics

have shown that enterprises with local ties to the university have greater advantages in improving the quality of their knowledge resources (Barbosa & Romero, 2012; Fukugawa, 2013) and that SMEs are more likely to access new knowledge within the same state/territory (de Zubielqui et al., 2015). However, this could just as easily be the case for the remaining two enterprises, seeing as Aalborg University is the only university in this region of Denmark. Nevertheless, regarding the geographical characteristic, whether the sample illustrates a maximum variation can be debated. Regarding trade and type of knowledge-intensive service, I did not succeed in getting two SMEs from each category to participate. The list is distorted in that enterprises within (1) high-tech knowledge intensive-services are overrepresented, and (2) knowledge-intensive financial services as well as (3) other knowledge-intensive services are underrepresented. I could have chosen to leave out one of the cases from the first category, but I saw no reason for it. One could argue that Studiecykel.dk, Clienti and konXion share similar characteristics as they all have fewer than 30 employees, work on similar subjects, have existed for a maximum of five years and are located in the same city. However, I believe each of them could produce valuable insights. An enterprise of two employees still varies from one with 25 employees, and seeing as all three of them showed great interest in participating, I decided to include all of them.

3.3.2.1.2 Assumptions and expectations

Before the case studies, I wrote down a list of my prior understandings and assumptions. I did this to increase my reflexivity and to reflect explicitly on my sense-making and potential influence. By explicating these assumptions, it is more likely that exploring the area of study will happen on the premises of the human agent's constructions rather than on mine.

- I am going to find that SMEs do not in any way include the university or its scientific knowledge into their work procedures.
- SMEs will engage with a number of knowledge channels, but the university will not be one of them. I expect that 'popular science', i.e. articles from videnskab.dk, will be used to a greater extent.
- SMEs will not experience a need for scientific knowledge. Part of the reason for this will be that they will not know what this knowledge is or where to find it.
- SMEs will not be using scientific knowledge explicitly. They might draw upon it through employees who have a university background.
- SMEs will rarely or never have used VBN. I expect that they will not mention it at all.
- VBN is too complicated and time-consuming for SMEs.
- If SMEs mention having used scientific knowledge, it will primarily be in the form of relational pathways such as collaborations with students or researchers.

3.3.2.1.3 Conducting the case studies

The eight case studies generally followed identical procedures. Through e-mail correspondence, I arranged a visit at each SME with a contact person. I had informed the contact person what I needed from the visit:

1. An introductory tour of the enterprise (go-alongs)
2. An interview with a manager or the CEO
3. Time to sit alone and make notes
4. Interviews with different types of employees

The introductory tour included a showing of the physical settings of the SME. It included a presentation of the firm's history and its employees, provided by the person giving the tour. Usually it was the CEO who gave this tour. In one SME, a secretary did it instead because of busyness. During the introductory tour, I observed the physical arrangement of the enterprise: How were the offices and work places arranged; what tools were available; how did the arrangement in offices invite or hinder talk and collaboration amongst co-workers; and what artefacts were present. I also observed their ways of working: Did they have separate offices or a joint office space; did they small talk to each other while working; did they collaborate on assignments; and so on. See Appendix 2.1 for a small Observation Guide used in the studies. In most cases I also had the opportunity to talk to employees during the introductory tour. Collectively, observing the physical arrangement gave indications about the work environment and work culture. For example, in some of the SMEs the offices are decorated with drawings and personal pictures. In others, a more clinical atmosphere dominates, which can be caused by a lack of personal artefacts and common areas. During these tours, I audio recorded what was said, I made field notes about my own understandings in a notebook and I took pictures throughout.

The interview with the CEO focussed on understanding the enterprises' missions, goals and overall working methods. The questions asked included what the core output and line of business of the enterprise was, what programs and tools they had available, how many employees they had, what their vision was, what a typical workday looked like and what a typical assignment was, what divisions and professions they had, what the educational background of the typical employee was, how they worked and collaborated in the enterprise, how they characterised themselves, what knowledge was to them, what competencies and expertise they found relevant, where they found their knowledge, what knowledge they acquired in-house and what external knowledge they needed, and where they found it, how they solved problems, how they understood the university and if they used scientific knowledge in their everyday work, and so on. See Appendix 2.2 for the full interview guide.

After the interview, I had time to sit alone and reflect on the impressions. I made further field notes and I sketched the physical arrangement (the floor plan) of the SME.

Finally, I interviewed different employees. I had asked the contact person in advance to schedule interviews with employees from different divisions, with different job assignments, with different educational backgrounds and so forth. Again, the result was a mix of what was purposive and what was convenient. How much planning my contact person had done prior to my arrival varied a great deal. On one occasion, I was simply told to go around the offices and try to find someone to interview. Other times, a complete schedule with times and room numbers was printed and ready for me upon arrival. What happened most often, however, was that my contact person had made a few loose arrangements on my behalf and then asked me who I preferred to talk to. In all cases, I took what I could get. The number of interviews ranged from one to five. In Studiecykel.dk for example, there were only two employees, where one was the CEO. In that case, it was not possible to conduct more interviews. In doing the interviews, I prioritised outlining their everyday situations and processes at work. The questions I asked included what their typical workdays looked like, how and where they spent the majority of their time, what programs and tools they used, and for what purposes, who their close colleagues were, and how they worked together, what types of problems they typically faced, how they solved problems, what knowledge meant to them, where and when they sought new knowledge, and what potentials (and obstacles) they identified related to finding and implementing new knowledge. Another goal of these interviews was to learn about the respondents' relationships with universities. I asked them about their immediate understanding of universities and scientific knowledge if they had ever used scientific knowledge in their current work, and what obstacles/potentials they identified related to using scientific knowledge. See Appendix 2.3 for the full interview guide.

After the interviews, the visit ended. On a few occasions, I was invited to stay for lunch. Afterwards I left. I promised each of the SMEs a follow up on my results. As a consequence, after processing and analysing the data, I sent each of them a mini-analysis of my data from visiting them. Two of them replied to this, indicating that they found it interesting to read.

3.3.2.1.4 Pilot study

The Clienti case served as a pilot study. The point of the pilot study was to test the research design, the interview guides and the data-creation methods. If something did not work as intended, I was prepared to adjust the structure. This also meant that the data from the Clienti case could potentially be ruled out due to inconsistencies in the data material. After the pilot study, I made minor adjustments to the interview guides. What primarily came out of doing the pilot study was an awareness of my own behaviour and role. For example, one of the interviews from the pilot study took only nine minutes, simply because I was rushing too much to get it finished. This was also because I had to find respondents myself – as mentioned earlier, this was the case where the enterprise had not made any arrangements for me. However, it taught me that I had to take my time, reflect on the process and insist on getting answers to my questions. It taught me that I had to phrase the questions more precisely and wait for the respondent to think about it and answer.

Enterprise name	**Date of visit**	**Respondents**
Studie-cykel.dk	15th of May 2014	(1) Owner and Sales Manager; (2) Communicator
Bjørk & Maigård ApS	28th of May 2014	(1) Partner and Constructing Architect; (2) Technical Assistant; (3) Constructing Architect; (4) Accountant; (5) Architect
konXion	20th of June 2014	(1) Owner/partner; (2) Community Manager; (3) Graphic Designer; (4) PHP Web Developer; (5) Social Media Developer and Instructor
Clienti	24th of June 2014	(1) CEO/partner (2) Frontend Developer; (3) Creative Director; (4) Project Manager; (5) Communication Director
Musikkens Hus	25th of June 2014 and 27th of June 2014	(1) CEO; (2) Program manager; (3) Manager of sales and marketing; (4) Event coordinator; (5) Ticket and information coordinator
RTX	4th of July 2014 and 9th of July 2014	(1) CTO, Design Services; (2) Vice President, Design Services; (3) Senior Project Manager; (4) Engineer; (5) Project Manager; (6) CEO, Development and Operations
Neas Energy	8th of July 2014	(1) Head of Communications; (2) Senior developer and team leader; (3) Head of Risk Management & Quantitative Analytics; (4) Trader; (5) Quantitative analyst and portfolio manager
Nordjyske Bank	18th of August 2014	(1) Manager of private customers; (2) Manager of business customers; (3) Back office employee; (4) Guidance counsellor; (5) Private customer counsellor

Table 3.2. List of cases, interviews and respondents

Even though Clienti was used as a pilot study, the structure of the data corresponds to the structure of the data from the remaining studies. Since no grave changes were made to the interview guides, I fully believe that the data from this case can be incorporated in the study on equal terms with the others. However, due to the lack of persistence to get answers on my account, the data will not be able to create quite as many themes in the analysis process, which I will present later.

3.3.2.2 Types of data

Creating data for this study meant to provide insights to the perspectives (local knowledge) of SMEs. The goal was to create a broad understanding of SMEs and their situation. To understand a situation, Clarke (2005) recommends striving to uncover who and what are in a situation, who and what matters in a situation, and what elements make 'a difference' in a situation. Accordingly, different types of data that allow for such insights were created.

3.3.2.2.1 Participative observation and 'go-alongs'

Observation is a method used to record and analyse behaviour and interactions as they occur in their natural context, although the researcher is not necessarily a member of the study population (Ritchie, 2003). The researcher can have a different role in different types of observation studies, ranging from non-participant observer to convert full member (Bryman, 2012). In any version, the social world is 'seen' through the eyes of the researcher and the difference is related to the degree to which the study population contributes to the construction of knowledge. In this study, a partially participatory observation method was used to co-construct understandings and interpretations of the situation of SMEs. In participatory observation, the researcher is conducting the observations while participating in the activities and natural context of the study population. It is this type of observation that took place in this study, specifically by the use of a 'go-along' (Kusenbach, 2003) inspired method. A 'go-along', being a hybrid of observation and interviewing, is an ethnographic research tool that brings to the foreground some of the transcendent and reflexive aspects of lived experience as grounded in place. According to Kusenbach (2003), a purely observational approach provides insufficient access to the experiences and understandings of the study population because they do not get the chance to comment on 'what is going on'. Sit-down interviews, he states, are also insufficient, because they usually keep the study population from engaging in their natural context, which makes it difficult to grasp what exactly the subjects are talking about. In a go-along, the researcher is able to observe the spatial practices of the research population in situ and access their experiences and interpretations at the same time.

Kusenbach (2003) distinguishes between two types of go-alongs: Natural go-alongs, and contrived or experimental go-alongs. In this study, a variant of a natural go-along was conducted. In a natural go-along, the researcher follows participants around in their natural context and tracks outings they would go on anyway as closely as possible. However, while I followed participants around in their natural context, the go-along was not a natural process per se. Rather, it was a guided tour of their enterprises that took place on my request. Accordingly, I was an active participant (Bryman, 2012) because I influenced the settings of the go-along quite a lot. During the tour, I conversed with the person giving the tour and had the chance to observe employees working and sometimes ask them questions. Going along with employees, observing the informants' spatial practices in situ while accessing their experiences and interpretations at the same time gave me a sense of the physical surroundings and how it affected the working situation. By that, the observations also helped form the following semi-structured interviews, because some questions occurred as a result of the observations. By that, the situation itself was allowed to influence the data creation.

While the Observation Guide (Appendix 2.1) was created in order to systematise the creation of this type of data, the data from the go-alongs was not systematically processed, which means that it was not consistently transcribed or documented. It served mainly as a supplement to my own understanding of the physical aspects of the situation prior to the in-depth interviews with CEOs and employees.

3.3.2.2.2 Interviews

Language is a powerful tool used to illuminate meaning and, accordingly, research interviewing can be understood as a social knowledge-producing activity (Brinkmann & Kvale, 2015). The interviews of this study took the form of individual, face-to-face verbal interchange. A total of 37 semi-structured lifeworld interviews (Brinkmann & Kvale, 2015) were conducted. Eight of these were with CEOs and the like, following Interview Guide 1 (Appendix 2.2), while 29 were with different types of employees, following Interview Guide 2 (Appendix 2.3). All interviews were transcribed and can be found in full length in Appendix 2.4 – 2.40. The interviews make up the primary data for the analysis of the situation of SMEs. A semi-structured lifeworld interview is inspired by a phenomenological knowledge ideal. Accordingly, questions asked are oriented towards exploring human and social experiences of lifeworld phenomena. Answers given reflect the situation as it is experienced by the respondents, not as it is (ideally) imagined. By that I acknowledge that respondents might do one thing but prefer to do another. To avoid my own sense-making influencing the answers, the questions were primarily open-ended (Bryman, 2012) with no answering categories. For example: “Can you describe a typical work day?” or “What do you do when you get an assignment you do not know how to solve?” or “Can you tell me about a situation where you had to look externally for new knowledge?”. This does make the categorisation of answers more complicated, but it also helps to avoid predeterminations. However, the interview guides are indeed influenced by my perspectives and the research orientation is clearly seen, for example through the focus on the university, which few respondents mentioned on their own initiative. Further, as mentioned in Section 3.2.2, I continually focussed on checking my interpretations with the participants.

The interview questions were made from an immediate understanding of what insights were needed in order to answer the research question. This understanding came from literature, from reflecting on the research question and from my general engagement in the area of study.

All interviews were conducted by me, audio-recorded and then transcribed, also by me. Note that all interviews were conducted in Danish and that the transcripts are also in Danish. For analytical purposes, selected quotes have been translated to English and will be presented in Chapter 5.

3.3.2.2.3 ***Photography***

During the go-alongs I had permission to photograph artefacts and physical arrangements. It was used in order to document SMEs’ social architecture and physical working environment: How were they organised; did their arrangement invite collaboration (shared offices or private offices); and what tools did they have available?

3.3.2.2.4 ***Drawings***

Based on the go-alongs, I sketched the floor plan of the individual SME. It was another way to document their physical arrangements, if it proved necessary.

3.3.2.2.5 ***Field notes***

During all eight case studies, I made field notes of what I saw and heard outside the immediate context of the interview or the observation. According to Schwartz-Shea and Yanow (2012), field notes, in a diary-like fashion, record the day-to-day activities, events and interviews, plus researcher sense-making. By that, field notes were a method used to avoid my own assumptions dominating the understandings acquired. Field notes are a method for documenting the data-creation process and what transpires in the field. The field notes in this study were not a systematic description of the entire course of a case study, rather they contained supplementary notes about my immediate feelings, thoughts on potentially relevant subjects and ideas for conclusions or interpretations. The field notes were written by hand during the studies. By that, they could function as a supplementary data type to the interviews, if it proved to be necessary.

3.3.2.3 Data analysis strategy

As already stated, the goal of studying the situation of SMEs was to explore the characteristics of their situation, especially in relation to knowledge and scientific knowledge. Accordingly, the analytical strategies and techniques had to allow for this to come through. In the following, I will present how the data will be analysed, how I get from analysis to interpretation, and how the results will be used.

3.3.2.3.1 Thematic analysis

Analysis is essentially a process of breaking data down into smaller components. Displaying qualitative data is about showing, arranging, putting in place and performing a description of something (Dahler-Larsen, 2008). In order to display the data created in Study B, I will conduct what can be termed a cross-case thematic analysis. A thematic analysis, despite often not being named a method (Braun & Clarke, 2006), is a common type of qualitative analysis and refers to the process of seeking to identify patterns in a data material. A thematic analysis offers an accessible and theoretically flexible approach to analysing qualitative data, which is in line with the research logic of the thesis. Identifying patterns in data material is the starting point for most forms of qualitative data analysis (Bryman, 2012) and it echoes the procedures of both situational analysis and Grounded Theory, which have served as sources of inspiration for this study.

The word ‘thematic’ relates to the aim of searching for aggregated themes within data (Gibson & Brown, 2009). When analysing the data, I will identify patterns across the data set and seek out patterns of meaning, which, according to Gibson and Brown (2009), can be done by examining commonalities, differences and relationships. To examine commonalities involves pooling together all examples from across a data set that can be categorised as ‘an example of x’. To examine differences involves looking for distinctive features across a data set by which the aim is to find and analyse the peculiarities and contrasts within a given data set. To examine relationships involves looking at the way in which different codes and categories relate to each other and to general themes.

There is no clear agreement about what thematic analysis is and how you go about doing it. However, it is acknowledged that thematic analysis differs from other analytic methods that seek to describe patterns across qualitative data (Braun & Clarke, 2006). For example, thematic analysis differs from Grounded Theory and Interpretative Phenomenological Analysis, which are theoretically bounded in seeking patterns. It must then be concluded that a thematic analysis is not theoretically bounded. Rather it can be used as an exploratory and inductive way of opening up a dataset and splitting the data material into themes which are, consequently, strongly linked to the data itself. "A theme captures something important about the data in relation to the research question, and represents some level of patterned response or meaning within the data set" (Braun & Clarke, 2006, p. 82). By and large, themes: (1) Are categories identified in the data by the analyst, (2) relate to the research focus (and quite possibly the research question), (3) build on codes identified in transcripts and/or field notes, and (4) provide the researcher with an understanding of the data material that can make a theoretical contribution to the literature relating to the research focus (Bryman, 2012). More on themes and codes shortly.

3.3.2.3.2 Methodological decisions regarding the analysis

According to Braun and Clarke (2006), a number of choices need to be explicitly considered and discussed when conducting a thematic analysis, i.e. what counts as a theme, how will the dataset be presented, will the analysis be inductive or theoretical and will the themes be semantic or latent? To make my understanding of a thematic analysis in the context of this study clear, I will reflect on these choices.

As mentioned earlier, I do not aim at 'thick descriptions' of the cases. Understanding the individual case and the situation per se is not the goal. Rather, conducting a cross-case analysis of the situation of SMEs related to knowledge work will allow for meaning-making and contextuality across cases to appear. In doing a thematic analysis, I aim at creating a 'generalised' set of data that speaks to a range of individual experiences (Gibson & Brown, 2009), which correlates with the goal of the study. By that, I move further away from the philosophy of situational analysis and in doing so, some of the depth, complexity and particularities of the cases examined will be lost. However, as mentioned above, the goal is to understand SMEs' as broadly perceived, hence why I render this loss of complexity acceptable. In analysing the situation of SMEs, the interview data will be the primary material. The remaining data types are supplementary and were created primarily to secure access to the full 'situation' of SMEs if it proved to be necessary, which relates to the need for a flexible research design. However, I will restate that the analysis will not consist of eight case studies, but rather of a thematic analysis of the insights provided by the 37 interviews.

As addressed briefly already, the analysis will follow an inductive logic. This means that the thematic analysis is data-driven and that data will be coded without fitting it into a pre-existing coding frame. Thus, I understand thematic analysis as an exploratory and inductive way of opening up a dataset and splitting the data material into themes. Thus, my goal in analysing the cases of SMEs is to generate theoretical arguments and conceptual ideas. Compared to the results of the Literature Study, these will be used for a discussion and theorising on communicative principles for the dissemination of scientific knowledge, which will then answer the third sub-question (SQ3): What are the communicative principles for the dissemination of scientific knowledge to SMEs?

The 'level' of which themes are to be identified is primarily semantic. In a semantic approach, themes are identified within the explicit meanings of the data, that is, from what was actually said. The challenge is then to move from description and organisation of patterns into themes and on to interpretation, where there is an attempt to theorise the significance of the patterns and their broader meanings and implications (Braun & Clarke, 2006).

Now, what counts as a theme? How are themes created, analysed and interpreted? These are the next questions to be answered.

3.3.2.3.3 Defining codes and themes

A code and a theme are not the same. While codes are organised, meaningful groups of data, themes are units of analysis, which are often broader than codes (Boyatzis, 1998). Different codes can be sorted into potential themes.

To code is to create a category that is used to describe a general feature of data (Gibson & Brown, 2009). Two types of codes can be distinguished: (1) Apriori codes, which are defined prior to the examination of data and (2) empirical codes, which are generated through exploration of the data. Apriori codes relate firmly to the research interests. Empirical codes might be a derivative of an apriori category or something entirely new that was not foreseen in the original research formulation. According to Gibson and Brown (2009), all codes are simply categories of data that represent a thematic concern.

A theme, on the other hand, builds on the codes that are identified in the data. By that, a theme is a 'category of codes', put together by the researcher because it relates to the research aim in some way. A theme has an 'expression'

(Ryan & Bernard, 2003), which is found in texts, images, sound and objects. According to Ryan and Bernard (2003), themes are abstract and come in all shapes and sizes. Citing Opler (1945), Ryan and Bernard (2003) state that themes are only visible (and thus discoverable) through the manifestation of expressions in data. Ryan and Bernard (2003) thoroughly discuss the nature of a theme and outlay the diverse terminology used in different social scientific disciplines. As they show, 'categories', 'labels', 'expressions', 'incidents', 'segments', 'data-bits', 'units' and 'concepts' are just some of the terms used across disciplines.

The analytical task is to identify codes, group them into themes and interpret them in relation to the sub-question of the study and ultimately in relation to the answer of the research question of the thesis.

3.3.2.3.4 Processing the data

It is an analytical task to provide some coherence and structure to the data set while retaining a hold of the original accounts and observations from which it is derived. While there are few specifications of the steps of a thematic analysis, Braun and Clarke (2006) do offer a step-by-step guide in which to find inspiration. It has six phases: (1) Familiarising yourself with your data, (2) Generating initial codes, (3) Searching for themes, (4) Reviewing themes, (5) Defining and naming themes and (6) Producing the report.

I conducted the coding manually. Seeing as I have planned, completed, transcribed and analysed all of the 37 interviews, I became very familiar with the data. When transcribing the interview data, I used the comment function in Word to note down immediate thoughts on specific pieces of data. By doing that, transcribing the interviews functioned as a first read-through and it generated an initial list of ideas about what was in the data and what was interesting about it. After transcribing the interviews, every interview was read through at least two more times.

The interview questions functioned as the first thematic categorisation. The final themes ended up along the lines of the initial interview questions, however, during the processing of the data, the themes were refined, renamed, one was deleted and others were spilt into two. By that, the themes can be defined as somewhat apriori, while the codes cannot. The codes were all purely empirical in that they were created from an exploration of the data.

An Excel file was created containing a column for every interview question (initial theme) and rows for each of the respondents. From every one of the 37 interview transcripts, pieces of data were cut out of the Word document and pasted into the Excel file under the relevant theme. That way I ended up with an Excel file containing thematic columns where all codes appeared. Not all respondents answered all questions and, accordingly, not all rows were filled out in all columns.

The Excel file contained a lot of data that needed further processing and analysing. The next step was to boil down the pieces of data – which were often quotes in their original form, to shorter sentences. By that, this process involved interpretation. I strived to transform the quotes semantically (according to what was actually said), but sometimes it was necessary to take the context of the quote into account. The next process was to boil these shorter quotes down to single words used by the respondents themselves. In a third processing, this was turned into word categories, which can be termed 'a posteri codes'. I will give an example of these three processings. To the question: 'How do you look for new knowledge?', the first pieces of data cut from the Word document and pasted into the Excel file are answers such as "I take courses when I can", "I use Google a lot, I really do" and "We use each other a lot". Next, these were transformed into "courses", "Google" and "colleagues". Here, "colleagues" is an example of a quote where I had to look at the context to make sure who the respondent was referring to. In the third round, they were transformed to "Courses and further studies", "Online search" and "Colleagues". These, then, were the codes of the theme called "Channels to new knowledge". Appendix 2.42 – 2.44 contains the iterations of coding in Excel files. The final codes and themes will appear from the analysis itself, which is presented in Chapter 5.

What follows is a brief methodological reflection on my way of generating codes and themes. Firmin (2008) states that themes are typically derived from codes generated by the researcher. This is what it means to be inductively driven, he says; to begin with the data and from it draw conclusions. However, it is actually not what I have done. On the contrary, I have let the themes be somewhat established up front and from them derived the codes. This can be understood as a source of error according to the purely inductive thematic analysis. However, I did create the data with a goal in mind. The data was created with the purpose of answering the research question. By that, the themes being somewhat predefined is only natural. The important thing, I find, is that the codes were empirical and that the themes were open for being refined. What turned out to be in fact relevant could only be disclosed by the data. For this reason, refining the themes was an important part of keeping the exploratory and inductive logic of the study.

3.3.2.3.5 Analytical presentation of data

The themes, sub-themes and their codes make up a data material ready for analysis and interpretation. This type of data can be used to compare and distinguish patterns, which is exactly the goal of this type of analysis. However, it is a rather quantitative way of presenting otherwise qualitative data. Codes and themes can be presented statistically, which will form a large part of the analytic foundation in this study. Another part of the analysis will be to illustrate and explain the individual themes. This will be done by using quotes from the transcripts to exemplify them. Note that while the transcripts are in Danish, the quotes selected for analytical presentation are translated to English. However, using quantitative data presentation in an otherwise predominantly qualitative study calls for some reflection: The intention is to analyse both in-depth and at the same time make a comparative analysis of the data possible; to display both variations and commonalities. Displaying the data, which means to make a list of themes or phenomena that fall within a certain category (Dahler-Larsen, 2008) allows for both qualitative and quantitative representations of the data. By that, understanding the group of cases is the main goal. Choosing a maximum variation sample for the study allowed for an identification of what is 'normal' and what is 'abnormal'.

3.3.2.3.6 Reflexivity on researcher sense-making

The researcher plays an active role in a thematic analysis. Themes do not just emerge from the data, they must be identified, selected (valued) and reported (Braun & Clarke, 2006). As an interpreter of the data, I am neither neutral nor unbiased. I make decisions on relevance according to the research aim of the study, and I am the interpreter of the data. Consequently, my meaning-making (my values, beliefs and feelings) will influence the research as I cannot "check it at the door" (Schwartz-Shea & Yanow, 2012, p. 98). I bring my theoretical and other expectations with me, which is unavoidable. For this reason, I made an effort to openly present my methods for data creation and analysis, thus allowing for a discussion about the research process and the resulting conclusions. Further, through self-awareness and reflexivity I aim at recognising my own sense-making processes and create awareness of my own potential biases.

3.3.3 STUDY C: STUDYING A RESEARCH INFORMATION MANAGEMENT SYSTEM

In this study, the VBN database (Knowledge Base of Northern Jutland) will be analysed. Research Information Management Systems are commonly used by universities to manage and disseminate scientific knowledge, and VBN is an example of such a system. VBN contains a large amount of existing scientific knowledge, i.e. publications, datasets and professional activities. These knowledge products will serve as examples of existing scientific knowledge in this thesis. The aim of Study C is to understand the database, its content and the organisation hereof, thus illustrating its possibilities and restrictions. This will be the foundation for the Development phase of the thesis, where a generic pathway will be developed in order to explore and concretise how scientific knowledge (Pure data) can be *reorganised*.

By that, Study C will be a single case study, where the case is chosen beforehand. As mentioned in Chapter 1, it has been a predefined condition for the PhD project since its launch that it explored dissemination of *existing* scientific knowledge from the online Research Information Management System of Aalborg University's Library as a case. Accordingly, reflections on screening criteria and selection processes are unnecessary. I do, however, understand VBN to be a 'typical' case (Yin, 2009), because this database uses the same system (the Pure research intelligence system) as all other Danish universities (Elsevier, n.d.-a). Choosing a typical case for this study is an appropriate strategy in order to understand and exemplify how Danish universities commonly organise their scientific knowledge.

The study will consist of a basic examination and description of 'what is there'? By a descriptive examination of VBN, the purpose of this study is to make clear what possibilities and limitations exist, what data is available, and what data can be subtracted and in which form. The study will include (1) a presentation of Pure, (2) a description of VBN and its purpose, (3) an analysis of the construction of the VBN database and (4) an analysis of the content (Pure data) and its organisation.

3.3.4 STUDY D: WORKSHOP STUDY

Study D is the first study of the thesis' Development phase. The studies of the Development phase will collectively make up the foundations for answering the fourth sub-question (SQ4): How can a generic pathway disseminate scientific knowledge based on an understanding of the situation and preferences of SMEs? By that, this phase adds to the answer of the research question in that it explores how the insights acquired in the first part of the thesis can be transformed into a concrete example of a generic pathway that disseminates scientific knowledge to SMEs. By that, although this phase of the thesis engages in a development process, the objective is still explorative. The design is not the goal, it is a means to an explorative end in that it makes it possible to test how existing scientific knowledge can actually be disseminated using generic pathways, thus allowing me to go a step further in the explorative process and supplement the answer of the research question with practical perspectives.

The Development phase was realised in collaboration with a professional digital agency with expertise in user experience, usability and development of digital solutions. Their role in the process was to conduct the actual coding, development and design of the generic pathway. Accordingly, a project manager, a UX designer and a digital designer facilitated the Workshop Study. I participated in the workshop as a co-facilitator. I organised it on the basis of a research objective, I selected participants, I assisted the creation of user's innovation, and I participated in the transforming of results into a new product. Further, I participated in the idea-generating processes of the workshop. Although I intentionally kept a low profile, I was not neutral – quite the reverse. As a result of my research objective, I influenced the workshop and its output quite a lot. But I focussed on letting the participants do the talking and participated primarily as an observer, taking notes. Letting the digital agency run the iterations of idea generation abated my influence on the generation of knowledge.

Conducting a workshop study is a method to operate with users in design processes and to ground innovation in their needs and values (Kanstrup & Bertelsen, 2011). A workshop brings together diverse stakeholders to do common work, to produce common outcomes, and to develop a plan of joint action (Muller, 2003). Thus, a workshop study is a method to ensure a two-way discussion, co-operation and co-creation. The purpose of the Workshop Study was to generate conceptual ideas for an actual generic pathway, which would later be developed. By that, this study is also explorative; new insights on the social phenomenon must be created. To avoid predeterminations and keep the explorative nature of the study, different stakeholders participated in the process as co-creators of ideas. Methodologically, a workshop study is a way to gain access to the shared beliefs, situated meanings and 'common-sense thinking' of relevant stakeholders. By that, the Development phase is based on intersubjective understandings and an interpretation of the social reality of relevant stakeholders, including SMEs. A central aim of the study was to create an atmosphere where negotiation, co-creation, brainstorming, dreaming scenarios (Jungk & Müllert, 1989; Vidal, 2007), creating new ideas and voicing your doubts was welcomed.

A total of 16 stakeholders participated in the Workshop Study. While Kanstrup and Bertelsen (2011) recommend eight plus two extras if possible, Jungk and Müllert (1989), recommend a maximum of 15-20. This workshop finds itself in between these recommendations. The participants included:

- Employees from seven different SMEs
- Two professors from Aalborg University
- A chief consultant from the VBN Editorial Office
- A Product Manager and the Head of Product Strategy from Elsevir
- A Project Manager, a UX Designer and a Digital Designer from the digital agency

Again, choosing participants was a mixture of what was purposive and what was convenient. To convince SMEs to take time out of their busy schedules is not an easy task, and once again I received several refusals. However, my goal was to include some SMEs that had also participated in Study B and some who had not, which was attained: Two of the participants had also participated in the previous study; five had not. I also aimed at including participants who worked within different types of knowledge-intensive services and at different geographical locations (still within Northern Jutland). However, as it turned out, one participant was from an enterprise larger than an SME, another was from an SME that did not fall under the knowledge-intensive category. However, the latter had been in contact with the university on previous occasions and expressed a great interest in scientific knowledge in relation to her business. They describe their business as 'an incubator to the hairdressing business' and, accordingly, scientific knowledge can be of interest and relevance to them.

Enterprise name	**Subject**	**Number of employees**	**Location**	**Type of knowledge-intensive service**
WICE	Psychological consulting	1	Aalborg	(2) Knowledge-intensive market services
Studie-cykel.dk	Marketing and sustainability	2	Aalborg	(2) Knowledge-intensive market services
My & Holger	Hairdressing and styling	11	Aalborg	-
Musikkens Hus	Concerts and cultural activities	150	Aalborg	(4) Other knowledge-intensive services
Gatehouse	Software and satellite communication	60	Nørresundby	(2) High-tech knowledge- intensive services
Nordjyske Bank	Banking and financing	250	Sæby	(3) Knowledge-intensive financial services
Hjørring Kommune	Local government	>250	Hjørring	(2) Other knowledge-intensive services

Table 3.3. SMEs participating in the Workshop Study

The Workshop Study was carried out on February 3rd, 2016. It took place at a conference centre, a so-called neutral site or 'third space' (Muller, 2003) in order to make the process as collaborative as possible. Besides an introduction to the context of the workshop and a short round of presentations, the workshop consisted of three phases: (1) A silent brainstorm, where the participants individually noted down their immediate ideas for a solution, (2) two card-sorting assignments, where participants were grouped in order to note down all ideas and functionalities they could think of, followed by an instruction to sort them according to relevance, and (3) a 'dream' phase, where participants drew and described their ideal interface.

Processing the data was very much a collaboration between the digital agency and me and my supervisor. However, a systematic recording of data was only done by the digital agency. The data consisted of Post-its, posters and drawings, which I will elaborate on in Chapter 7. After the workshop, we shared our thoughts on the activities, we gave them our notes, and then they went on to the process of transforming the ideas into an actual digital product. By that, while we had the main job of interpreting the ideas of SMEs and determining the principles behind the design, the digital agency had the main job of transforming it into an actual design. During the Development phase, we communicated with the digital agency via Yammer, a professional networking site, where it is possible to share material and ideas. That way we were able to follow their process and share our thoughts on their work. After approximately one month, they delivered the first version of a digital interface, which was to be further developed in collaboration with the users, the SMEs.

3.3.5 STUDY D: USABILITY STUDY

To test the user's attitude towards the first version of the digital interface, a Usability Study consisting of seven tests was conducted. *Usability* means to match products and systems closely to the needs and requirements of the users, and to make products and systems easier to use. The primary goal of a usability test is "to determine whether an interface is usable by the intended user population to carry out the tasks for which it was designed" (Preece, Sharp, & Rogers, 2015, p. 457). In such a test, two things can be tested: (1) The *use-ability* of the interface, that is are SMEs able to use it (Nielsen Norman Group, n.d.-a) and (2) the *user experience*, that is the needs and desires SMEs have related to using the interface (Nielsen Norman Group, n.d.-b). In this study, we tested a bit of both. We tested the concept of the interface and we tested the use of it. In a way, we tested whether we had made a 'correct interpretation' of the SMEs' ideas from the Workshop Study. The purpose of the Usability Study was to test the interface and its design on several parameters, including:

- Content: Is the text and content understandable?
- Design and colours: Are the visual elements in accordance with the preferences of SMEs? Is it up to date according to trends and tendencies?
- Functionalities and layout: Are the functionalities and the structure of the interface understandable and usable in accordance with the purpose of the interface?
- Concept: Does the overall concept make sense according to SMEs?

The Usability Study was designed and facilitated by the UX designer from the digital agency. I participated primarily as an observer. The study involved a line of questions (Appendix 4.1) and some instructions to move through the user interface to see its content, design and functionalities. The usability tests were conducted on an iPad and strictly followed the same procedure.

The usability tests took place in the physical location of the SMEs. There were two reasons for this. First, us coming to them made it a whole lot easier for SMEs to take time out to participate in the study. Second, we wanted to test the interface in the working environment of the SMEs, which is the environment where it was meant to be used.

The usability tests were structured as a 'Thinking Aloud Test' (Nielsen, n.d.). In a Thinking Aloud Test, you ask test participants to use the interface while continuously thinking out loud, that is simply verbalising their thoughts as they move through the user interface. Such a test requires three things: (1) To recruit representative users, (2) to give them some representative tasks to perform and (3) to allow *them* to do the talking. According to Nielsen (n.d.), this method serves as "a window to the soul, letting you discover what users really think of your design". In that way, it is a method perfectly in line with the methodology of the thesis.

Regarding the choice of participants, I ran into the same problems as in the previous studies: SMEs are busy and short on time for purposes other than their primary conduct of business. Consequently, while I aimed at purposively choosing SMEs, it was again (also) a question of what was convenient. However, I did succeed in finding a varied group of SMEs, although their variations were not 'maximum' on all parameters. A good thing about the SMEs that participated in this study is that they include one SME that also participated in Study B, one that participated in Study C and one that participated for the first time. That way, the Usability Study could test the concept on users who participated in the generation of the idea and on 'objective' users.

Enterprise name	**Subject**	**Number of employees**	**Location**	**Type of knowledge-intensive service**	**Number of usability studies**
Jysk Vindenergi	Wind energy	2	Nørre-sundby	(2) Knowledge-intensive market services	2
Gatehouse	Software and satellite communication	60	Nørre-sundby	(2) High-tech knowledge-intensive services	3
RTX	Engineering and technology development	165	Nørre-sundby	(2) High-tech knowledge-intensive services	2

Table 3.4. Participants in the Usability Study

Two types of data were produced in the Usability Study and were used to document the usability tests. The first was written notes by both the UX designer and myself. The second was visual and audible recordings from the iPad that recorded the actions and sounds of the entire process.

The data from the Usability Study was primarily analysed by the UX designer from the digital agency. Immediately after the usability tests, we shared our thoughts and I gave him my notes. The analysis focused on exploring what changes had to be made to the interface before a second version of the prototype could be launched. In analysing the data from the Usability Study, the UX designer looked for patterns. After the analysis, the digital agency incorporated the changes in a further development of the interface.

The Usability Study was conducted on the 29th of March, 2016.

3.3.6 STUDY F: EVALUATION STUDY

The final study of the thesis is an Evaluation Study. By this point in the thesis, a prototype of a generic pathway based on insights from the previous studies of the thesis will have been fully developed. As a final research endeavour of the thesis, the goal of the Evaluation Study is to use the concrete example of a generic pathway to explore whether it is a profitable way to disseminate scientific knowledge to SMEs. The Evaluation Study thus seeks to answer the fifth sub-question (SQ5): To what extent does the generic pathway that is based on an understanding of the situation and preferences of SMEs optimise the dissemination of scientific knowledge to SMEs? By optimise, I refer to whether it makes scientific knowledge more accessible, understandable, relevant, and useable to SMEs. It is beneficial to the answer of the thesis' research question to get an indication about whether or not the understandings provided by the thesis and put into practice improve the dissemination process. The focus of the Evaluation Study will thus be to supplement the explorative aim of the thesis with insights regarding the users' attitudes towards the generic pathway and their immediate opinions regarding whether it makes scientific knowledge appear accessible, understandable, relevant and usable.

An evaluation is a systematic collection of information about how a specific effort has been accomplished and how it has worked (Sloth, 2013). According to Preece et al. (2015), evaluators collect information about users' or potential users' experiences when interacting with a prototype. They can do this for two reasons, similar to the ones mentioned in Section 3.3.5: (1) To learn about the use-ability of the prototype in order to improve its design or (2) to learn about the users' experience when interacting with the prototype (e.g. how satisfying, enjoyable, or motivating the interaction is). The first can be labelled a *summative evaluation*, which is done to assess the success of a finished product. The second type can be labelled a *formative* evaluation, which is conducted during design to check that the product continues to meet the user's needs (Preece et al., 2015). The primary purpose of this study is to conduct a summative evaluation. Although the generic pathway is still only a prototype and not a finished product, it is the last version of the interface included in this thesis. The object of this Evaluation Study is thus to explore SMEs' attitudes towards the generic pathway and if they think the generic pathway disseminates scientific knowledge successfully. However, because the generic pathway is still only a prototype and will not have been launched, the Evaluation Study will be confined to providing insights on SMEs' attitudes rather than their actual use: What do they immediately think of the generic pathway; can they imagine using it in relation to their work? By that, because these understandings will be created by showing the generic pathway to the SMEs, the study could secondarily have a formative purpose. Because the Evaluation Study is confined to asking respondents about their *immediate* thoughts and their *expected* use, it can be said to provide insights to the imagined and short-term attitudes of the SMEs. Showing SMEs the generic pathway will give them something specific to relate to rather than asking about 'the dissemination of scientific knowledge' in general (as the previous studies of the thesis have done). By that, the Evaluation Study might very well provide insights into the usability of the generic pathway, which could be used to improve the design of the generic pathway, although it is not the primary purpose of the study.

Consistent with the remaining studies of the thesis, the Evaluation Study creates data on SMEs' meaning-making related to knowledge work and (potential) use of scientific knowledge. However, in this study, it has been deemed valuable to get access to a larger part of the SME populations' meaning-making processes. By that, quantification is introduced as a new aspect of the research logic of the thesis. For this reason, the Evaluation Study uses a social survey as a research method. A social survey contains specific structured and standardised questions (Bryman, 2012) and it creates data that can be 'counted', presented and analysed in order to find patterns. Further, a social survey allows me to reach a larger number of SMEs with different characteristics, which is profitable considering the rather broad SME definition (see Table 1.1). When using surveys, the focus is usually not on what any one individual has to say, but rather on generalising what a group, such as SMEs, has to say. That is also the purpose of the Evaluation Study, which is why a social survey is considered a reasonable research method for the study.

According to Buckingham and Saunders (2004), social surveys are usually either descriptive or explanatory. While descriptive research tries to describe a social phenomenon, and measure its incidence in a population, explanatory research tries to find evidence about some of the likely causes of the behaviour or attitudes of the population. As mentioned by Chenail (2011, p. 1713), "qualitative studies are most likely exploratory, naturalistic, subjective, inductive, ideographic, and descriptive/interpretive and quantitative studies are most likely confirmatory, controlled, objective, deductive, nomothetic, and predictive/explanatory". In line with the exploratory research design and the interpretative research epistemology of the thesis, the orientation of the Evaluation Study can be characterised as mainly descriptive. With this study, I seek to describe and explore what SMEs' attitudes towards the generic pathway are; I do not seek to explain the causes for these attitudes.

3.3.6.1 Thematising the survey

Table 3.5 provides an overview of key themes, key concepts and variables in the survey is provided. As already mentioned, it is the third key theme that the Evaluation Study mainly seeks insights to, but these insights must be understood in comparison to the first and second key theme.

Key themes	Key concept	Variable
SMEs' background	Their SME	Whether they work in an SME
		Whether that SME is geographically located in Northern Jutland
		What trade the enterprise is primarily in
		What their specific job position is
	Their prior relation to university	Whether they have ever attended university
Understanding of university	University and Scientific knowledge	How well they believe they know the university
		Whether they use university and scientific knowledge in their work (and if so how)
		What they think of the university
		Whether they experience scientific knowledge to be of value to their work
Attitude towards the generic pathway	The generic pathway	What do they think of it
		Whether they would use it
		Whether they find it relevant related to their work
		Whether they miss some functionalities

Table 3.5. Thematising the survey. Inspired by Buckingham and Saunders (2004, p. 62)

An assumption that turned out to be very defining for the design of the survey and its questions was that it would be very difficult to get people to answer it. The previous studies of the thesis had taught me that SMEs are unlikely to spend time on activities not related to the normal conduct of their business. As a consequence, I was very focussed on not making the survey too demanding or time consuming for SMEs to complete. Accordingly, questions for each key theme were kept to a minimum and made as simple as possible. For that reason, the main part of questions was closed questions with response categories. There were a few open ones but they were all voluntary.

For the third key theme, I needed to visualise the generic pathway to the SMEs in order to give them something specific to relate to rather than asking about 'the dissemination of scientific knowledge' in general. This, however, posed a bit of a challenge. If I gave them a link and asked them to visit the interface on their own, I feared that they would not return to finish the survey. If I merely showed them screen-shots, I feared that they would not get a proper understanding of the concept. I ended up going with a third option; showing them a video. I video- and audio-recorded my computer screen as I made a virtual tour of the generic pathway while explaining the individual aspects of it. The video can be found in Appendix 5.1.

The full survey can be found in Appendix 5.2.

3.3.6.2 Drawing a sample for the study

SMEs in Northern Jutland made up the target population for the Evaluation Study. I acknowledge that this can be perceived as a sample issue, because regional biases could be prevalent. For example, compared to other Danish universities, Aalborg University has a distinct tradition for problem-oriented student projects, which are often realised in collaboration with enterprises. This could have the effect that many enterprises in Northern Jutland are somewhat accustomed to being approached by the university and maybe also to participate in diverse studies. However, it has been a predefined condition for the PhD study from the beginning that it took a regional perspective and thus examined SMEs from Northern Jutland specifically (see Section1.6). As a result, this decision was not up for debate. According to numbers from the Central Business Register, there are 31.054 enterprises with 0-250 employees in the Region of Northern Jutland alone. This counts enterprises that are mother companies, that are not holding companies, and that are not estates of deceased persons. If I reduced the search to enterprises with minimum one employee and maximum 250 employees, the result was 8656 enterprises. This large reduction bears witness to a large amount of CVR registered one-man-businesses, of which many might be side-line occupations. Unfortunately, the data on CVR registered enterprises in Denmark does not allow for an exact extract in that regard. Getting a precise number of the total population of SMEs in Northern Jutland was therefore not possible. Accordingly, I had to strategically and methodically choose a sample to include in this study.

The aim in any sample is that its members should be broadly representative of the population from which they are drawn, and in this study I also aimed at choosing a sample that somewhat estimated the varied characteristics of the SME population in Northern Jutland. However, making a sample for this study was difficult. Once I again I faced the challenge of accessing the common-sense thinking of SMEs. Like in Study B, the Evaluation Study aimed at accessing the social voice of SMEs by exploring the meaning and relevance structure for the beings living, acting and thinking within the SMEs. In this study, it meant that I had to choose a frame of reference: Was it SMEs as units or was it individual employees in SMEs? To continue along the lines of the previous studies in the thesis, I selected a group of SMEs and attempted to get access to their 'social voice' (Clarke, 2005). In this quantitative study that meant to get different employees in the selected SMEs to answer the questionnaire. This stand opposed to asking one individual in a larger number of SMEs and then letting this one voice talk on behalf of the SME. However, one employee does not constitute the social voice of an SME according to the epistemology of this thesis. Therefore, attempting to get access to the social voice in a smaller number of strategically-chosen SMEs was prioritised.

Now, how is such a sample created? Like in Study B, I conducted a purposeful or purposive sample, which is a non-probability form of sampling – or quota sampling (Buckingham & Saunders, 2004) – where cases/participants are sampled in a strategic way (Bryman, 2012). Like in the previous studies conducted in the thesis, I wanted to ensure that there was a maximum variety (Patton, 1990; Sandelowski, 1995) in the key characteristics of the sampled SMEs. Since I had difficulties determining the actual population of SMEs in Northern Jutland, I instead chose the number of SMEs to participate in this study strategically, using categorisations of SMEs mentioned previously in the thesis. That is, (1) the SME definition which covers the category of micro, small and medium-sized enterprises (Table 1.1) and (2) the type of knowledge-intensive enterprises, which covers the category of: (a) High-tech knowledge-intensive services, (b) Knowledge-intensive market services, (c) Knowledge-intensive financial services and (d) Other knowledge-intensive services (Eurostat, n.d.). Further, I added a notion on geographical location. I purposely chose two SMEs from each category: One located in Aalborg (close to the university) and one located in a different municipality in Northern Jutland. The reason for this related to what I stated earlier in this chapter, that enterprises with local ties to the university have greater advantages in improving the quality of their knowledge resources (Barbosa & Romero, 2012; Fukugawa, 2013). Purposely choosing SMEs that are within the same municipality as the university and SMEs that are not was a way to ensure a larger variety in the sample. Furthermore, once again I strived to include SMEs that had participated in previous studies of the thesis and SMEs that had not. Put into a matrix, the sampling strategy looks as follows:

Type of knowledge intensive service / **Size** (number of employees)	High-tech knowledge-intensive services	Knowledge-intensive market services	Knowledge-intensive financial services	Other knowledge-intensive services	Location
Micro (0-10 employees)	x	x	x	x	Aalborg munici-pality
	x	x	x	x	Another munici-pality
Small (11-50 employees)	x	x	x	x	Aalborg munici-pality
	x	x	x	x	Another munici-pality
Medium (51-250 employees)	x	x	x	x	Aalborg munici-pality
	x	x	x	x	Another munici-pality

Figure 3.3. Sampling strategy for the Evaluation Study

Figure 3.3 illustrates my interpretation of a maximum variety sample in the context of this study. In other words, with this approach I aimed at creating a sample with as large a variation as possible that would also provide the insights to 'the general' understandings of SMEs. As Figure 3.3 shows, the sample for the Evaluation Study could include 24 SMEs, and for each of these 24 SMEs, selected employees would receive a personal invitation to participate in the Evaluation Study.

What SMEs were chosen in the individual categories was a matter of convenience. As expected, it turned out to be very problematic to get SMEs to participate in the Evaluation Study. I used the Central Business Register to find enterprises for each category and then I used their respective websites to find a relevant contact person, usually a manager or owner. I would then call this person up and explain about the survey and the purpose. While many SMEs agreed to participate, most of them were uncomfortable sending the survey out to a large number of employees. The main reason for this was that they were too busy and that taking up so much time would be unacceptable. One SME even did a calculation for me: "Even though it only takes 10 minutes, that is 10 minutes times 60 employees which is 600 minutes which is 10 working hours and it is not possible for us to spend 10 working hours on something that is not directly related to our core business". Accordingly, I had to reduce my expectations regarding how many employees from the individual SMEs would receive the survey. Instead, I had to simply take what I could get. It ended up being somewhat out of my control how many employees from the different SMEs got the survey, because the contact person in all instances preferred to send the survey to relevant employees he or she selected himself/herself. Therefore, I had no control over what types of employees received the survey in each SME. I did, however, ensure that the contact person told me how many employees he/she forwarded it to. That way, it was still possible for me to know the total number of respondents that received the questionnaire. These numbers appear from the following figure and indicate how many employees the SME has and how many of these received the survey. The numbers in red specify the SMEs that have participated in previous studies in the thesis.

Type of knowledge intensive service / **Size** (number of employees)	High-tech knowledge-intensive services	Knowledge-intensive market services	Knowledge-intensive financial services	Other knowledge-intensive services	Location
Micro (0-10 employees)	3 (3)	1 (1)	1 (1)	1 (1)	Aalborg municipality
	2 (2) 1 (1)	3 (3)	1 (2)	3 (6)	Another municipality
Small (11-50 employees)	1 (30)	42 (42)	20 (29)	2 (11)	Aalborg municipality
	1 (25)	18 (18)	5 (23)	5 (17) 1 (25)	Another municipality
Medium (51-250 employees)	75 (75)	2 (54)	-	180 (180)	Aalborg municipality
	6 (80) 16 (165)	5 (50)	-	-	Another municipality

Figure 3.4. The sample of SMEs for the Evaluation Study

As Figure 3.4 shows, there were issues regarding the sample. First of all, for three of the 24 categories, an SME matching the criteria did not exist or was not willing to participate. Second, for another three categories, there ended up being two participating SMEs instead of one. I did not plan for this; it was a consequence of a long-winded communication and indecision from some SMEs. As a result, the sample ended up consisting of 24 SMEs with a total population of 844 employees, of which 395 received the survey. Out of these 395, I received 121 responses. This calculates as a response rate of 30,63 percent. Whether or not this response rate is acceptable can be debatable. According to Sax, Gilmartin and Bryant (2003), the available literature on web surveys points to widely varying response rates. Further, more studies have shown that paper-and-pencil surveys elicit a higher response rate than online surveys (Nulty, 2008; Sax et al., 2003). Nulty (2008) examined response rates for different online surveys and found that the average response rate was 33 percent. This is not a benchmark, but it can be used as an indicator. Looking at some of the publications included in the Literature Study (Chapter 4) that conducted surveys amongst SMEs can give an indication about response rates in this concrete area of study. Targeting directors of Italian academic departments engaged in research in the Engineering and Physical Sciences, Muscio and Vallanti (2014) got an 18,8 percent response rate. Asking firms engaged in technology transfer partnerships with universities, Sherwood and Covin (2008) got a response rate of 24,6 percent. Focusing on the business unit, Bruneel et al. (2010) got a response rate of 19 percent. Surveying industrial project leaders in Taiwan, Sher, Shih and Kuo (2011) got a response rate of 11,2 percent. Studying all SMEs in the Adelaide Metropolitan area, de Zubielqui et al. (2015) got a response rate of 13,03 percent. Collectively, this indicates that response rates in surveys targeting SMEs are relatively low. By that, a response rate 30,63 percent seems acceptable.

The survey was conducted as a web survey and administered online via the program SurveyXact during October and November 2017. First, I conducted a pilot study with participants from two different SMEs. After that, I sent a link to the questionnaire in a personal email to all contact persons in the selected SMEs and they could then forward it. The cover letter of the email contained a short introduction to the study and the survey.

3.3.6.3 Displaying the data

The data in this study will be displayed primarily using graphs and statistics. However, when the data allows for it (that is, when respondents have chosen to fill out the open-ended questions in the survey), I will display quotes that elaborate on the statistics and provide a more in-depth perspective on the data.

CHAPTER 4: LITERATURE STUDY

In this chapter, the Literature Study (Study A) will be carried out. The study will be conducted as a systematic literature review, which differs from traditional narrative reviews by adopting a reliable and rigorous process that reduces subjective bias and lowers the risk of overlooking relevant literature (Ankrah & AL-Tabbaa, 2015). The study aims at providing an answer for the first sub-question (SQ1): What problems and solutions are known and addressed in relation to the dissemination of scientific knowledge to SMEs?

4.1 STRUCTURE AND CONTENT OF THE REVIEW

This chapter will involve reflections on the structure and the content of the review, followed by the actual review. As described earlier, the review is divided into four phases:

1. Determining the goal(s) of the review
2. Searching for and selecting publications
3. Analysing the data
4. Writing the review

4.1.1 DETERMINING THE GOAL(S) OF THE REVIEW

The main purpose of doing a literature review is to understand the existing literature in the field and advance a collective understanding from it (Boote & Beile, 2005). As mentioned in Section 3.3.1, the goals of this Literature Study are to (1) structure an overview of the literature within the area of study, and (2) explore the barriers to the successful dissemination of scientific knowledge, thus (3) creating a foundation for answering the research question.

As mentioned earlier, the area of study in the thesis is composed of two subjects not commonly examined together: (1) The dissemination of scientific knowledge (2) between universities and SMEs in particular. Within this merged area of study, different reviews could rightfully be conducted. For this reason, determining the goals of the review involves outlining some screening criteria to clarify which publications will be included and excluded, and why. In other words, the purpose of such screening criteria is to make valid decisions about what is *relevant*. The screening criteria stem from the thesis' research question and from the defined goals of the review. Accordingly, I am choosing publications that:

1. Analyse problems or barriers to the dissemination of scientific knowledge between knowledge institution and enterprise, and/or
2. Outline designs and/or models for the dissemination of scientific knowledge between knowledge institution and enterprise, and/or
3. Pass on experiences about the dissemination of scientific knowledge between knowledge institution and enterprise.

Publications included in the review must meet one or more of these criteria. A couple of things should be noted about these screening criteria. First, I purposely write ‘knowledge institution’ and ‘enterprise’ instead of ‘university’ and ‘SME’. The reason for this is that using the specific terms ‘university’ and ‘SME’ would limit the literature search significantly and, consequently, very few publications would be included. Broadening the terms and including similar organisations allows for a larger number of relevant publications to appear in the search and, accordingly, to acquire more valuable insights about the area of study. Collecting a large and diverse amount of publications and examples to include in the review will create a valid foundation for the thesis and serve as inspiration for later phases in the thesis. Secondly, the screening criteria do not involve any notion about the publications’ use of research methods, theories or empirical justification. However, in order to understand whether the claims are warranted or not, it is relevant to take into consideration the research methods and empirical foundations of the publications included in the review (Boote & Beile, 2005). In this aspect, a somewhat motley picture is painted. Out of the 61 entries included in the review (this number will be deduced and explained in the following), no clear empirical tradition exists, which is illustrated in Figure 4.1.

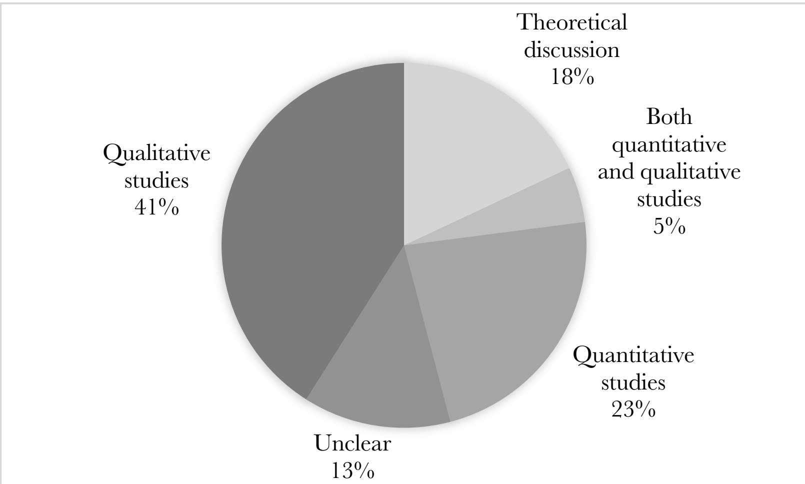

Figure 4.1. Research methods used in the review publications

While the greater part of the publications uses mainly qualitative research methods such as interviews, case studies or round table discussions, quantitative methods, which are primarily referring to questionnaires and surveys, are also frequently used, as well as purely theoretical discussions. A small group of publications use a mix of quantitative and qualitative methods. All of these are arguably valid foundations. More questionable are the 10 percent of publications based on the authors' own reflections and especially the three percent where the research method is simply unclear. Naturally, less emphasis should be put on publications of this character. However, because the goal of the literature review is to find basic insights related to the overall dissemination process and experiences with it, non-scientific sources might still provide valuable perspectives. As a consequence, publications with subjective statements and even those with an opaque research method could potentially be of value and will therefore not automatically be ruled out. In conclusion, the point of the screening criteria is to make possible a review that explores a group of diverse examples – from different perspectives and using different methods – that can illustrate the practices of disseminating scientific knowledge between knowledge institutions and enterprises in general, and between universities and SMEs in particular.

4.1.2 SEARCHING FOR AND SELECTING PUBLICATIONS

The goal of a literature search is to collect a large amount of relevant publications (Randolph, 2009). Doing a systematic literature review involves searching for, collecting and screening a large number of publications. The method for such a collection must be well-reflected and documented. In the following, I account for my approach.

I found that the literature search got rather complicated rather fast. The reason for this is that the terminology within the area of study is very diverse, which was addressed in Section 2.2. The main components of the literature search are 'university', 'SME', 'knowledge dissemination' and 'scientific knowledge'. It so happens that there are several different ways to refer to all four of these components. As discussed in Section 2.2, knowledge dissemination is merely one term amongst many used more or less synonymously. Accordingly, literature relevant to include in this review will be using different terms for the same process. The same goes for 'university' and 'SME' and to a lesser extent for 'scientific knowledge'. Accordingly, I have to include all possible synonyms for all four components in the search strings. Another thing that complicates the search is that the area of study is not limited to one scientific discipline. Far from it. For example, I cannot limit the search to journals of communication or business. Relevant insights can also be found within journals of law, music or medicine. Disseminating knowledge happens in many situations and contexts and none of them can automatically be deemed irrelevant. Thus, the question of relevance reappears. Accordingly, I widened the search by incorporating different scientific areas, traditions and databases. This created an increased need for a qualified relevance assessment, which I will get back to.

I found it relevant to include publications in both Danish and English. However, a systematic search for Danish publications was deselected, since the databases available did not allow it. I did a test-search in databases such as *bibliotek.dk*, *Ncom* and *Den Danske Forskningsdatase*. The results were very incomplete, and consequently, the search in English was prioritised. The fact that a systematic search in Danish was difficult to complete indicates a lack of focus and research within this area of study.

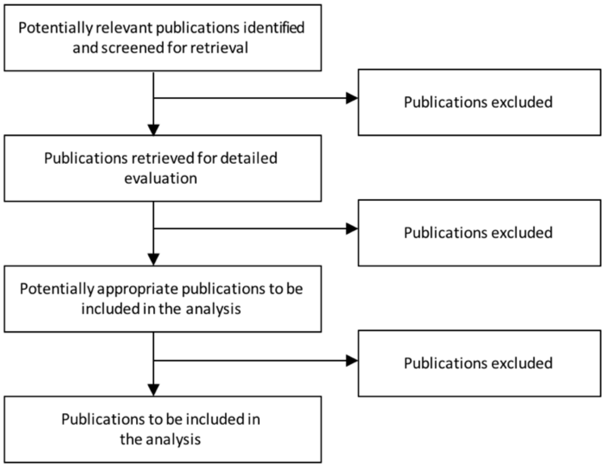

Figure 4.2. Procedure for the Literature Study. Inspired by Bargas-Avila & Hornbæk (2011, p. 3)

To collect publications from different disciplines, I found inspiration from Bargas-Avila and Hornbæk (2011), who adapted a specific method from Moher et al. (1999) used to select a representative extract of publications to be included in a literature review. Originally, the method was a procedure for conducting meta-analysis, which is a process of taking a large body of quantitative findings and conducting statistical analysis in order to integrate those findings and enhance understanding (Cronin et al., 2008). Seeing as I do not intend to do a statistical analysis from the review, I restricted myself to using their method for the collection and selection of publications. The method consists of four phases intended to make the search for and collection of publications accurate. As Figure 4.2 illustrates, these phases are: (1) Potentially relevant publications identified, (2) Publications retrieved for detailed evaluation, (3) Potentially appropriate publications and (4) Publications to be included in the analysis. The method requires a thorough search for publications as well as a qualified assessment of them.

4.1.2.1 Potentially relevant publications identified and screened for retrieval

The first step was to choose sources (journals and databases) for the search. A preliminary search in Google Scholar on 'knowledge sharing' and 'university industry' showed that existing literature is published in a range of different journals. Amongst the first 10 search results, only two were in the same journal and all represent different scientific disciplines: *Technovation*; *Journal of Industrial Engineering and Engineering; Research Policy; International Journal of Management; Journal of Product Innovation; Science Research Management; The Journal of Technology Transfer; Journal of Supply Chain Management;* and *European Journal of Innovation Management.* This illustrates how difficult the area of study is to delimit. As a consequence, selecting journals to be included in the review was not a preferable course of action. Instead, I chose a number of recognised databases to conduct the search in. Collectively, these databases access publications from a variety of scientific areas. From these, a representative extract of publications could be found. The choice of databases was made from Aalborg University Library's descriptive list of databases (Aalborg University Library, n.d.). From this list, I selected five interdisciplinary databases: *ABI-Inform* (ABI), *Academic Search Premiere* (ASP), *Business Source Premiere* (BSP), *ProQuest Research Library* (PQRL) and *Web of Science* (WoS). Originally, two more databases were on my list: Wiley Online Library and Scopus. These were deselected because of technical issues. Wiley Online Library does not give you an option to only search for peer-reviewed publications, so extracts from calendars, job adverts and portraits of writers appear in the search results. This made the search unnecessarily disordered. Scopus continued to display an error message, so I opted out.

I have limited the search to the time period 1985-2015. The reason for the upper time limit is that this is when the literature review was conducted. The reason for the lower time limit is that the publication of the Bodmer Report in 1985, which I discussed in Section 1.2, is frequently mentioned as the launch pad of the science-society debate (Davies, 2008; Kim, 2007; Miller, 2001). Thus, including literature back to 1985 will give a thorough understanding of publications and events within the dissemination of scientific knowledge.

4.1.2.2 Search strings

I made a search string for each of the four main components of the area of study; 'university', 'SME', 'knowledge dissemination' and 'scientific knowledge'.

As already mentioned, there are several synonyms for each of these components, and I attempted to include as many as possible. The search strings looked like this:

1. "Information transfer*" OR "Knowledge transfer*" OR "knowledge exchange" OR "Science journalism" OR "Knowledge creation and transfer*" OR "Knowledge spillover*" OR "Knowledge sharing" OR "Science communication" OR "Research communication" OR "Knowledge dissemination" OR "Knowledge translation" OR "Knowledge brokering" OR "Knowledge translation" OR "Technology transfer*"
2. "universit* industr*" OR "Universit* to industr*" OR "U/I" OR "academia industry" OR "universit* business*" OR "universit* to business*"
3. Industr* OR business* OR SME* OR "small and medium sized" OR "small and medium enterpri*" OR "small and medium"
4. Universit* OR "Scientific World" OR "Academic knowledge" OR "Scholarly knowledge" OR "Scientific knowledge" OR "Academic World" OR "Scholarly world"

4.1.2.3 Search procedure

The search was conducted on the 22nd of September 2015. The search strings were entered into each of the five databases. In all databases, the chosen time interval was typed in to limit the search. In ABI, ASP, BSP and PQRL it was possible to further limit the search to peer-review entries, which I did. In WoS, the search was automatically limited to peer-reviewed entries. Furthermore, in ABI, ASP, BSP and PQRL it was possible to choose that the search words had to appear in the abstract. This was an advantage, primarily because of the word 'university', which could potentially have led to all entries with a writer affiliated with a university to be included in the search, which was not my intention. In WoS this was not an option, and instead I chose that the search had to be in 'topic'.

The results of the search were as follows: ABI =127, ASP = 85, BSP = 134, PQRL = 39, WoS = 428. The potentially relevant publications identified and screened for retrieval totalled 872 (n=872).

4.1.2.4 Publications retrieved for detailed evaluation

All publications from the previous phase were imported to a Zotero library. Out of the 872 entries, 268 were duplicates. When these were removed, 604 entries were left.

4.1.2.5 Potentially appropriate publications

The goal of this phase was to narrow the entries down to 1) original full papers, that are 2) written in English and 3) speak in a broad sense about the area of study (Bargas-Avila & Hornbæk, 2011). First, I had to find full text versions of all entries. Please note that this was done online, which meant that entries that could not be accessed via my university's licenses or other available online sources had to be abandoned. Out of the 604 entries, there were 144 not available or accessible to me in full text versions. Accordingly, 460 entries were left. In the next selection, where entries are limited to English texts, 29 entries were deselected. Thus, n=431.

4.1.2.6 Publications to be included in the analysis

In this phase, abstracts from all of the 431 entries were read and assessed in order to decide which publications to include in the analysis. This is what Randolph (2009) calls 'data evaluation' and what Cronin et al. call (2008) 'Read'. This will be done using the screening criteria from Section 4.1.1.

My Zotero library allowed me to automatically download all abstracts into a Word document. On several occasions, however, reading the abstract alone was not enough to make a valid assessment of relevance. I had to read the entire article to determine if it should be included in the analysis or not, because the abstracts are often short and use terms other than 'knowledge dissemination', e.g. 'business engagement activities' or 'utilisation of academic knowledge'. Even though the screening criteria somewhat delimit what is relevant and what is not, this phase will inevitably involve some interpretation of relevance. The screening criteria cannot function as a categorical and conclusive instruction, which is a consequence of the versatility of the area of study. It is not possible to list screening criteria strictly enough to avoid interpretation and simultaneously not rule out potentially relevant entries. I will give an example. A publication can deal with patenting between university and industry, but focus on understanding policy procedures rather than learning about patenting as a way to connect university and industry. Because the screening criteria are somewhat abstract, a publication can fit within the search without being relevant for the goal of this Literature Study. This, however, could be perceived as a source of error regarding the screening criteria, which I will try to diminish by the following approach:

After reading through the 431 abstracts, I waited a few weeks to put a little distance between myself and the material and I then repeated the process. The first 'test' read of the abstracts gradually made me aware of which publications I would deselect and why. I deselected entries where *the main goal* is to learn about:

- The university or the researcher's point of view. In accordance with the methodology of the thesis, I sought to address the area of study from SMEs' point of view. Accordingly, publications included in the Literature Study can contribute to this. As a consequence, I also excluded publications that address: barriers related to the researcher's personal or scholarly characteristics; the organisational conditions of the university; administrative obstacles in the university; students or PhD candidates as knowledge disseminators.
- Academic entrepreneurship, which is mostly on patent-based activities such as spinouts and licensing (see for example Abreu & Grinevich, 2013).
- Relational pathways such as 'collaborative research' and the like, where establishing, maintaining and completing personalised collaborations between university and industry is the goal. This is in line with the research question of the thesis (Section 1.6), where exploring the dissemination of existing scientific knowledge using generic pathways is the goal.
- Funding and policy, which involves policies and government activities related to knowledge dissemination (see for example Bozeman, 2000).
- Geographical location or regional/locale conditions. On a similar note, I deselected the entries where a comparison of countries or organisations was the goal.
- TTOs (Technology Transfer Offices), which serve as the gateway to university inventions and have traditionally been a popular mode for knowledge commercialisation (see for example Khademi, Parnian, Garmsari, Ismail, & Lee, 2014).

After the second read-through of the abstracts, I found that the selection and deselection of entries were now valid and substantiated. In this fourth phase I deselected 348 entries, thus ending up with 83 entries (n=83) to be included in the analysis.

4.1.3 ANALYSING THE DATA

> "You cannot simply read all these documents, take casual notes, and then write a literature review. Instead, you will need to develop narrative summaries and coding schemes that take into account all the pertinent information in the documents. The process is iterative, meaning, for example, that you might need to develop a coding scheme, apply it to the documents, revise it based on this experience, and re-apply it."(Gall, Borg, & Gall, 1996, p. 159)

In order to ensure a systematic approach for analysing and synthesising the literature, I followed the PQRS system (Cronin et al., 2008). The PQRS system has four stages to ensure a focused, consistent and easy identification of material when a large number of publications is being reviewed. The first stage is 'preview', where a first read of the publication or its abstract is done to get an overview of its content and possibly undertake an initial classification. This stage is similar to the fourth phase of Bargas-Avila and Hornbæk's (2011) approach, which I already did. The second stage of the PQRS system is 'question', where questions are systematically asked of each publication. This is where the real work of classifying the content in the publications begins. Rephrasing the screening criteria, which were introduced earlier in this chapter, and which originated from the goal of the review and from the research question of the thesis, I already have the relevant review questions (RQ):

- RQ1: What problems or barriers to the dissemination of scientific knowledge between knowledge institution and enterprise does the publication address?
- RQ2: What designs and/or models for the dissemination of scientific knowledge between knowledge institution and enterprise are outlined by the publication?
- RQ3: What experiences of the dissemination of scientific knowledge between knowledge institution and enterprise are passed on by the publication?

Each of these review questions will be asked systematically of each of the 83 publications included in the review. Cronin et al. (2008) suggest following an indexing system, or what is called a coding scheme in the citation above, to assist this process of asking and answering the review questions. They also recommend including particulars of each publication in this indexing system to avoid misunderstandings later on. Following this advice, I created an indexing system in an Excel file and made room for each of the three review questions to be answered, and for particulars to appear as well:

- Title
- Writer(s)
- Year of publication
- Type of publication
- Place of publication

The fourth stage of the PQRS system is to write a short summary of each publication. I incorporated this in my indexing file, plus an optional field of adding my own immediate thoughts and ideas about the publication. By that, I included my immediate thoughts as data in the further process, which is an introspective way of providing data, related to the methodology of the thesis.

- Summary of the publication
- My own immediate reflections

Collectively, the abovementioned points make out the indexing system that is the foundation of the analysis of the selected publications. Following the advice from Cronin et al. (2008), I consistently asked all review questions of all publications and noted down the answers in the Excel file. However, I am aware that not all of the three review questions can necessarily be answered by each publication.

I began the third stage of the PQRS system on the 10th of November 2015 and finished it on the 15th of April 2016. After reading each of the publications thoroughly, it became evident that some publications – despite appearing relevant when reading the abstract – were not relevant to include in the analysis. This was the case when the publication did not provide an answer to any of the three review questions. In order to keep the focus of the review on point, I chose to add a fifth selection phase, where I removed another 22 entries due to lack of relevance. In conclusion, the final number of entries included in the analysis is 61 publications (n=61). A list of these entries can be found in Appendix 1.1.

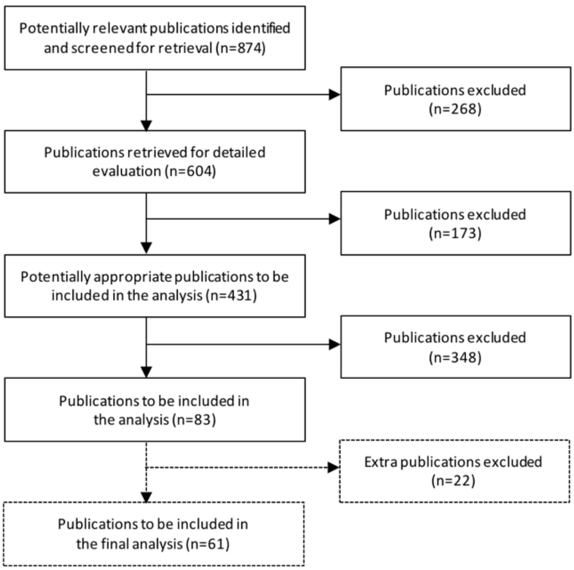

Figure 4.3. Final process of selecting publications for the Literature Study

When stage three of the PQRS system was completed, I had an Excel file filled with data for analysis. The form of this data varied: citations; reproduction of text; reflections; and summaries. To process this data further, I used a qualitative open-coding process of examining, comparing, and categorising the data during several iterations (Bryman, 2012; Kvale & Brinkmann, 2015; Strauss & Corbin, 1990). I categorised the data from all of the answers to each of the review questions, and after several iterations, concepts emerged. This work is in line with what Cooper (1988) calls a *conceptual organisation* of literature, where work related to the same abstract ideas appear together, which differs from a historical or methodological organisation (Cooper, 1988). My work with creating concepts can be seen in Appendix 1.2. These concepts, categorised according to review questions, make out the analytical foundation of the review.

4.1.4 WRITING THE REVIEW

Having finished reading the publications and answering the review questions, I had divided the analytical material into three categories (one for each review question, see Section 4.1.3) consisting of different concepts. In writing the review I aim at clearly displaying these concepts according to category. The analytical data material clearly showed that most of the publications address RQ1 about barriers and problems with the dissemination of scientific knowledge. Because this majority is so significant, I chose to structure the review around RQ1 and incorporate RQ2 and RQ3 when relevant, which is in line with the recently-mentioned conceptual structure.

As a consequence of the conceptual structure, the review will be built up from categorising and analysing the barriers to the dissemination of scientific knowledge between universities and SMEs. Understandings related to the two remaining review questions will be added continually.

It is important to mention that the review publications primarily focus on the dissemination of scientific knowledge between university and industry at large, and not specifically SMEs. Actually, out of the 61 review publications, 39 do not even mention SMEs. Thirteen mention SMEs briefly, while only nine actually address SMEs. Accordingly, the problems and barriers to the dissemination of scientific knowledge that are brought to light in the review publications are primarily results of studying enterprises overall and not specifically SMEs. This is not unimportant. Naturally, publications dealing with SMEs as a specific type of enterprise are very interesting according to the goal of the review. Review publications dealing specifically with SMEs will provide very accurate knowledge on SMEs' role in the dissemination process. For this reason, I will emphasise when SMEs are specifically mentioned in the publications. However, the insights provided by the review publications apply to enterprises at large, including SMEs. I consider the lack of specific knowledge about SMEs to be a justification of the thesis' focus on SMEs. Knowledge regarding this specific type of enterprise is scarce, which is why providing it is valuable. Conducting the review will be a contribution to a greater understanding of this specific type of enterprise's part in knowledge dissemination. Furthermore, the understandings from this review will form the basis for the remaining studies of the thesis, which will empirically develop and substantiate these insights.

The review publications use a variety of terms for (more or less) the same process as I have chosen to refer to as 'knowledge dissemination'. As far as possible, I will stress the term used by the individual publications. When concluding and summing up understandings, I will use 'knowledge dissemination', since it correlates to the rest of the thesis.

4.2 THE LITERATURE REVIEW

I will begin the review with a categorisation of barriers to the dissemination of scientific knowledge between universities and enterprises (SMEs) mentioned in the review publications. Such a categorisation of barriers is also put forward in several of the review publications themselves. Some of these categorisations are more nuanced than others. A simple but relevant categorisation is found in Bruneel et al. (2010), who make an overall distinction between transaction-related barriers and orientation-related barriers. Transaction-related barriers are related to conflicts over IP (intellectual property) and university administration, and orientation-related barriers are related to differences in the orientation of industry and universities. Similarly, Bearden, Foster and Khan (1995) conclude that barriers are either managerial or technical in nature, falling into the realm of 'people' problems versus 'research application' problems. A more detailed categorisation is found with Ankrah and AL-Tabbaa (2015). As a result of a systematic review, they identify several factors that either facilitate or inhibit university-industry collaboration. They divide these factors into seven categories: (1) Capacity and Resources; (2) Legal Issues, Institutional Policies and Contractual Mechanisms; (3) Management and Organisational Issues; (4) Issues relating to Technology; (5) Political Issues; (6) Social Issues; and (7) Other Issues. Baycan and Stough (2013) list 'the bad' in bridging knowledge to commercialisation: (1) Conflicts of values; (2) Differences in cultures and perspectives; (3) Conflicts of interest; and (4) Conflicts in the commercialisation of knowledge. Vaidya & Charkha (2008) put forward a figure that depicts the factors impeding university-industry interactions. The figure serves as a categorisation of barriers and includes: (1) Result Publication; (2) Communication Difficulties; (3) Behavioural Issues in Collaboration; (4) Research Orientation; (5) Ineffectiveness of Research; and (5) Inhibition to Commercialisation.

Mentioning these other categorisations serves the purpose of introducing the common problems and barriers addressed in this field. From these different categorisations of barriers, and from reading all of the review publications, the categorisation I have constructed, and which will be elaborated on and analysed in the following, are barriers related to: (1) The size and resources of the enterprise; (2) Cognitive and social distance; (3) Communication; (4) Organisational structure and culture; (5) The characteristics of scientific knowledge; and (6) Rights and confidentiality.

4.2.1 BARRIERS RELATED TO THE SIZE AND RESOURCES OF THE ENTERPRISE

A group of barriers relates to the size and resources of the enterprise. In the review publications, it is commonly accepted that it is easier and more efficient for larger enterprises to collaborate with external sources, such as universities. One simple reason given for this is that larger enterprises have more resources available (Abbasnejad et al., 2011; Alves, Marques, & Saur-Amaral, 2007; Ankrah & AL-Tabbaa, 2015; Bodas Freitas, Geuna, & Rossi, 2013; Draghici, Baban, Gogan, & Ivascu, 2015; Lee & Win, 2004; Ramos-Vielba, Fernandez-Esquinas, & Espinosa-de-los-Monteros, 2010; Siontorou & Batzias, 2010). That SMEs have limited capacity and resources and that this is a barrier to the dissemination of scientific knowledge is also frequently addressed (Ankrah & AL-Tabbaa, 2015; de Zubielqui et al., 2015; Decter, Bennett, & Leseure, 2007; Fukugawa, 2013; Liew, Shandan, & Lim, 2013; Lock, 2010; Ranga et al., 2008; Yusuf, 2008). According to Ranga et al. (2008), SMEs in particular deserve special attention because of some specific characteristics that influence their innovativeness: entrepreneurial spirit, lack of bureaucracy, increased flexibility and ability to respond to unexpected developments in the field, close collaboration with suppliers and customers, generally limited financial resources, managerial capabilities and mechanisms for accessing knowledge from external sources. Bodas Freitas et al. (2013) explain this problem when stating that SMEs often possess few spare resources (financial resources, personnel, managerial skills) needed to initiate and organise a contract with a cognitively and socially distant organisation such as a university.

A number of the publications conclude that enterprises which invest in R&D (research and development) are more likely to obtain external knowledge, i.e. from universities (Abbasnejad et al., 2011; Acworth, 2008; Ramos-Vielba et al., 2010). On a similar note, Alves et al. (2007) emphasise that universities tend to have privileged relationships with large enterprises to the detriment of SMEs, the reason being that universities are more likely to cooperate with enterprises that invest in R&D and have human resources dedicated to that task, which usually means larger enterprises. Abbasnejad et al. (2011) also address this problem and point out that large enterprises can cooperate with partners more effectively than SMEs because large enterprises have more resources available to help them establish a relationship with partners. At the same time, they stress that SMEs tend to be more eager for external cooperation than large enterprises, as they face a lack of internal resources, especially related to finance, R&D capacity or facility. Decter et al. (2007) state that, ironically, enterprises that may be most able and likely to license university research are those who already have a reasonable level of research capability and contacts with the academic community. Ranga et al. (2008) point out that while large enterprises depend for their innovative output on direct and indirect R&D inputs, SMEs exploit more extensively the spillovers from research activities carried out by universities and by other enterprises. In that connection, a relevant point is found in de Zubielqui et al. (2015). The authors conclude that it is unhelpful to group all SMEs together, because there are important differences between medium, small and micro enterprises, especially in terms of understanding how they collaborate to access knowledge to innovate.

The attention to the size and resources of the enterprise is often related to the matter of *absorptive capacity*. Absorptive capacity is a well-known concept within the dissemination of scientific knowledge between university and industry. The term originates from a couple of papers by Cohen and Levinthal (1989, 1990) and refers to an enterprise's ability to use external scientific knowledge. The smaller the enterprise, the smaller the absorptive capacity. Muscio (2007) and Comacchio, Bonesso and Pizzi (2012) specifically mention that SMEs have less absorptive capacity than larger enterprises. By that, it is easy to conclude that since SMEs have a smaller absorptive capacity, they need more help accessing and implementing scientific knowledge. That a lack of absorptive capacity is an obstacle that impedes or draws out the process of disseminating scientific knowledge is a recognised understanding (Abbasnejad et al., 2011; Agrawal, 2001; Ankrah & AL-Tabbaa, 2015; Bodas Freitas et al., 2013; Kodama, 2008; Lakpetch & Lorsuwannarat, 2012; Massingham, 2015; Wang & Liu, 2007; Yusuf, 2008).

A few publications mention that enterprises experience or fear that engaging in a dissemination process with the university will be too time-consuming and will happen at the expense of other central assignments (Ankrah et al., 2013; Nielsen & Cappelen, 2014; Szejko, 2002). This can, to some extent, be a consequence of limited resources. SMEs cannot afford to spend time or resources on processes not producing profit. On that note, it is documented by some publications that enterprises can be unsure about the usefulness and quality of scientific knowledge (Ankrah et al., 2013; Lee & Win, 2004; Wang, 2013), which can also be explained by limited resources, both financial and timewise.

4.2.2 BARRIERS RELATED TO COGNITIVE AND SOCIAL DISTANCE

A fundamental barrier to efficient dissemination of scientific knowledge is that a cognitive and social distance exists between university and enterprise (Bellefeuille & Rice, 2002; Lakpetch & Lorsuwannarat, 2012; Muscio & Pozzali, 2013; Muscio & Vallanti, 2014; Santoro & Bierly, 2006). This distance can be observed on other levels too, for example that university and enterprises have different expectations, interests, motives or reasons to engage in knowledge dissemination (Foley, 1996; Gattringer, Hutterer, & Strehl, 2014; Muscio & Vallanti, 2014; Siegel et al., 2003). The primary difference regards the motive for engaging in dissemination processes. While universities want to develop knowledge, enterprises seek functionality, solutions and profit (Alves et al., 2007; Ankrah et al., 2013; Barbosa & Romero, 2012; Baycan & Stough, 2013; Boehm & Hogan, 2013; Chen, 1994; Hayes & Fitzgerald, 2009; Horng & Hsueh, 2005; Iskanius et al., 2014; Langford, Hall, Josty, Matos, & Jacobson, 2006; Liu, Liu, & Hsu, 2009; Szejko, 2002). Citing Brown & Duguid (2000), Bruneel et al. (2010) write that the university wishes to create 'leaky' knowledge so that their ideas will be acknowledged by their peers, while enterprises want the knowledge to be 'sticky' so that they can control a resource that is not available to their competitors. Others describe this difference as universities focusing on commercialising knowledge and industries focusing on keeping it secret (Gilsing, Bekkers, Freitas, & van der Steen, 2011; Lakpetch & Lorsuwannarat, 2012; Muscio & Vallanti, 2014).

Another type of distance regards behaviour. University and industry have different cultures, experiences, expectations and different strengths and weaknesses (Agrawal, 2001; Alves et al., 2007; Baycan & Stough, 2013; Decter et al., 2007; Fukugawa, 2013; Gattringer et al., 2014; Hansotia, 2003; Hayes & Fitzgerald, 2009; Lakpetch & Lorsuwannarat, 2012; Muscio & Vallanti, 2014; Ranga et al., 2008; Schofield, 2013; Sher et al., 2011; Siegel, Waldman, Atwater, & Link, 2004). This can cause tensions and difficulties creating and maintaining productive interactions or can mean that one or both parties are disappointed with the result. Alves et al. (2007) even state that the number of satisfactory relationships between university and industry remains very low, mainly because of mind-set divergences that obstruct cooperation and frequently hinder the achievement of common objectives.

An *intermediary* is often mentioned as a means to overcome institutional, cultural and social barriers (Acworth, 2008; Ankrah et al., 2013; Decter et al., 2007; Lakpetch & Lorsuwannarat, 2012; Yusuf, 2008). In the review publications, the intermediary is often a person who must mediate or translate between university and enterprise. However, of relevance to the research question of the thesis (Section 1.6), an intermediary can be more than a relational pathway. It can also be a generic pathway (a system, an interface or a communication product) that makes the dissemination of scientific knowledge easier and more successful.

Different time horizons are also a type of distance that constitute a barrier to the dissemination of scientific knowledge between universities and SMEs. While universities have long-term goals, enterprises often have short-termed goals (Alves et al., 2007; Ankrah et al., 2013; Barbosa & Romero, 2012; Bearden et al., 1995; Bellefeuille & Rice, 2002; Boehm & Hogan, 2013; Bruneel et al., 2010; Gattringer et al., 2014; Liu & Sharifi, 2008; Lock, 2010; Muscio & Vallanti, 2014; Ranga et al., 2008; Schofield, 2013). A tangible barrier identified by enterprises is that universities take too long publishing and commercialising their scientific knowledge (Hansotia, 2003; Lakpetch & Lorsuwannarat, 2012; Vaidya & Charkha, 2008; Yusuf, 2008). Thus, due to enterprises' short-termed goals, scientific knowledge is often automatically deselected. Siegel et al. (2004) writes that enterprises express great anxiety about 'time to market', which underlines that time horizons are an important factor for enterprises when engaging in dissemination processes.

Another type of distance is the geographical distance. 'Geographical proximity' is a factor that influences the efficiency of knowledge dissemination between university and enterprise, especially SMEs (Barbosa & Romero, 2012; de Zubielqui et al., 2015; Fukugawa, 2013; Mora-Valentin, Montoro-Sanchez, & Guerras-Martin, 2004; Wang, 2013). Fukugawa (2013) shows that among small technology-based enterprises engaged in cooperative research with university-based researchers, the enterprises with localised linkages have greater advantages in improving the quality of their knowledge resources than enterprises without local ties. It is indicated by de Zubielqui et al. (2015) that SMEs are more likely to collaborate and access new knowledge within the same state/territory. Furthermore, their study shows that SMEs in Australia overwhelmingly collaborate and access knowledge from organisations and use methods from within their more local environments, thus concluding that colocation appears particularly important to a university–enterprise knowledge transfer perspective. However, Mora-Valentin et al. (2004) found that, although a lot of previous studies have identified proximity as a success factor, it is not a significant variable.

The cognitive and social distances addressed above all constitute potential barriers to efficient dissemination of scientific knowledge between universities and enterprises. However, as stated by Hayes & Fitzgerald (2009), if university and industry cultures merge and become less distinct, it is possible that the complementary skills, abilities and knowledge that provide the rationale for university-industry collaboration will be lost. In this perspective, the social and cognitive distances that pose potential barriers to the dissemination of scientific knowledge between universities and SMEs simultaneously constitute a positive condition that, if lost, will reduce the value of the dissemination itself. This indicates that these differences between university and industry are not to be overcome, but rather to be understood and taken into account.

4.2.3 BARRIERS RELATED TO COMMUNICATION

Communication – or lack of communication – is frequently mentioned in the review publications as a barrier to the dissemination of scientific knowledge (Decter et al., 2007; Lakpetch & Lorsuwannarat, 2012; Mora-Valentin et al., 2004; Nielsen & Cappelen, 2014; Ranga et al., 2008; Schofield, 2013; Siontorou & Batzias, 2010; Szejko, 2002; Vaidya & Charkha, 2008; Wang & Lu, 2007). The perspectives on this category are many. Some find that the problem is a lack of interpersonal relations and communication (Alexander & Childe, 2013; Fukugawa, 2013; Gertner, Roberts, & Charles, 2011; Lee & Win, 2004; Wang, 2013). Others point out that contractual and sporadic contact, rather than long-term contact, is problematic (Alves et al., 2007; Chen, 1994; Nielsen & Cappelen, 2014; Santoro & Bierly, 2006; Wang & Lu, 2007). In a qualitative study involving representatives from both universities and enterprises, Boehm and Hogan (2013) find that the existence of open, honest, personal and especially frequent communication is believed to be a success factor for collaborations for all partners. Alexander and Childe (2013) conclude that face-to-face communication is the richest form of media, and that knowledge dissemination must be based on this form in order to be as successful as possible. On the other hand, Bruneel et al. (2010) and Liu and Sharifi (2008) find that several different channels must be used to ensure successful communication. Despite different recommendations in the review publications, the point is that it must be easy for enterprises to access scientific knowledge and to get in contact with the university. However, this is often not the case (Acworth, 2008; Bodas Freitas et al., 2013; Decter et al., 2007).

Bodas Freitas et al. (2013) suggest that SMEs involved in open technology and innovation development strategies use personal contractual interactions relatively more than institutional interactions. Contrary to this, the study by de Zubielqui et al. (2015) found that for SMEs collaborating with research institutes, knowledge is most likely to be acquired using generic, tangible transactional university-to-industry knowledge dissemination pathways, in the form of published research results and employment of new graduates. The authors point out that using generic pathways suggests weak ties in the search for useful knowledge, and that it is actually the relational pathways that require more developed and stronger ties that will engender higher trust levels and therefore lead to more effective knowledge dissemination. If this is accepted, it must be concluded that the most efficient knowledge dissemination happens between universities and larger enterprises. Related to the thesis' research question (Section 1.6), this is a valuable insight, seeing as it points out some fundamental conditions to be taken into consideration when developing the dissemination processes.

A relevant understanding of the situation of SMEs is found in Ranga et al. (2008), who cite Woolgar et al. (1998) when defining *the SME-centric universe*. In this approach, SMEs appear to be at the centre of their own world, not isolated, but relating most intensively with their suppliers and customers. Universities fall well outside SMEs' focus of attention, the reason being that SMEs have very specific and specialised concerns, to which the notion of 'research needs' is largely remote. Because of this, communication between universities and SMEs often fails to happen. A similar understanding is found in de Zubielqui et al. (2015), who state that SMEs will tend to form expressive ties with those organisations and people within their supply or value chain. Such organisations are primarily customers and suppliers. Universities, consequently, fall outside SMEs' focus of attention in relation to knowledge acquisition. This relates to what several publications term a lack of a 'pull' from enterprises (Bearden et al., 1995; Decter et al., 2007; Siontorou & Batzias, 2010; Szejko, 2002; Wang & Liu, 2007). A lack of motivation to acquire external knowledge results in passivity: The enterprises simply do not experience a need for scientific knowledge. On a similar note, enterprises often experience a lack of common interests and they find that scientific knowledge is not in sync with their needs (Alves et al., 2007; Barbosa & Romero, 2012; Bearden et al., 1995; Bellefeuille & Rice, 2002). Others mention that enterprises have a hard time identifying their own needs in relation to scientific knowledge (Alves et al., 2007; Bodas Freitas et al., 2013). Because science and technology are intangible factors for enterprises, they have difficulties identifying competitive advantages and to commit themselves to invest in them (Alves et al., 2007; Bearden et al., 1995; Bellefeuille & Rice, 2002; Lock, 2010; Nielsen & Cappelen, 2014; Ranga et al., 2008). Also, a lack of administrative resources can prevent SMEs from engaging in knowledge dissemination (Fukugawa, 2013; Gilsing et al., 2011; Lock, 2010). Besides limited resources, Lock (2010) explains that SMEs cannot assess the value of the process and that they find costs, together with university timescales, incompatible with their schedules.

Collectively, these circumstances imply that the university can be deemed irrelevant to SMEs' existence and success. This is fundamentally a communication problem. Bellefeuille and Rice (2002) point to the importance of enterprises being able to translate their organisational needs into the language of the other organisation, i.e. scientific language. The authors conclude that if industry is to be successful at learning from and leveraging the university's research capabilities (and vice versa), they must learn to change and be willing to move a little closer to one another. By this, they imply that knowledge dissemination demands something of enterprises that are an active part in the interaction. Now, an interesting question is, how do we get the enterprises to be willing and capable of change? On that note, Yusuf (2008) claims that unless enterprises proactively pursue innovation as a part of their competition strategy and seek out usable knowledge from universities, fruitful linkages will be slower to materialise. Furthermore, SMEs are less likely than large enterprises to initiate knowledge dissemination, although neither fully exploits the potential of universities in generating knowledge and technology.

Alves et al. (2007) conclude that the scientific community tends to be closed, having an introverted orientation and leaving little room for external intervention. Furthermore, they claim that universities usually lack proper mechanisms (channels) to disseminate scientific and technological offers. They point at 'co-ownership interfaces' as part of the solution. Owned by both university and enterprises, such interfaces can become cooperation platforms meant to improve the relationship between university and industry by helping universities to communicate more easily with enterprises, while simultaneously helping the enterprises to acquire competences and enlarge the knowledge base required to develop new technologies and products (Alves et al., 2007). Note that this idea of a co-owned interface is an example of how a generic pathway can be used as an intermediary, which I briefly discussed in Section 4.2.2. Others, (Ankrah & AL-Tabbaa, 2015; Decter et al., 2007; Kelli, Mets, Jonsson, Pisuke, & Adamsoo, 2013; Massingham, 2015) conclude that the lack of a functional interface or system for knowledge dissemination between university and enterprise is a central part of the problem. Kelli et al. (2013) find it to be essential that universities proactively contribute to the development of different collaborative arenas/platforms. Furthermore, universities cannot expect the collaboration with enterprises to just happen, which relates to the earlier point about SMEs lacking initiative. For dissemination of scientific knowledge to be successful, a systematic and continuous effort by universities and support of collaborative arenas are required.

Another relevant point frequently mentioned in the review publications is that universities are bad at marketing their scientific knowledge and that they need to do more in order to make industry aware of the possibilities is this regard

(Decter et al., 2007; Draghici et al., 2015; Philbin, 2012; Ranga et al., 2008; Schofield, 2013; Siegel et al., 2004). As a consequence, enterprises often do not even know that scientific knowledge from universities is available to them. This is an important barrier. Ranga et al. (2008) state that although SMEs only rarely interact with universities and similar organisations, it is not the result of a lack of interest but rather the consequence of poor or lacking communication and information about the opportunities offered by government and knowledge institutions, i.e. universities.

4.2.4 BARRIERS RELATED TO ORGANISATIONAL STRUCTURE AND CULTURE

This category is not concerned with differences between universities and enterprises as addressed earlier. Here, the focus is how the internal structure and culture of enterprises can be both conducive and restraining to the successful dissemination of scientific knowledge. It is often concluded that in order to ensure successful knowledge dissemination, the internal structure of an enterprise must allow the creation, collection, integration and dissemination of knowledge resources (Abbasnejad et al., 2011; Hansotia, 2003; Lakpetch & Lorsuwannarat, 2012; Nielsen & Cappelen, 2014; Santoro & Bierly, 2006). For example, it is stressed that enterprises must have established procedures and routines to effectively integrate knowledge (Abbasnejad et al., 2011; Hansotia, 2003; Lakpetch & Lorsuwannarat, 2012; Nielsen & Cappelen, 2014; Santoro & Bierly, 2006). Abbasnejad et al. (2011) and Barbosa and Romero (2012) mention that enterprises should even have a strategy for creating and developing knowledge. Others, however, claim that organisational structures are only rarely flexible enough to absorb new technology (Alves et al., 2007; Ankrah & AL-Tabbaa, 2015; Lakpetch & Lorsuwannarat, 2012). Bellefeuille and Rice (2002) and Lakpetch and Lorsuwannarat (2012) explain how management specifically can be a hindrance to this.

Regarding the internal culture, a group of review publications address how enterprises understand and position themselves in relation to knowledge and dissemination. Is the overall attitude of the enterprise open to learning, change and innovation? (Abbasnejad et al., 2011; Bodas Freitas et al., 2013; Massingham, 2015; Ranga et al., 2008; Szejko, 2002). Is management supportive and engaged? (Ankrah & AL-Tabbaa, 2015; Massingham, 2015; Ranga et al., 2008). These factors indicate how open an enterprise is to knowledge dissemination, which is relevant since a lack of openness can be a significant barrier. In that connection, two terms are relevant. Baltes (2000) mentions the so-called ‘innovation preventionists’, who, according to him, can be found in any organisation. Innovation preventionists are people who make a profession out of shooting down ideas and innovations. The ‘not invented here-syndrome’ is mentioned by more review publications (Baltes, 2000; Bearden et al., 1995; Decter et al., 2007; Sher et al., 2011) and covers a tendency to reject external knowledge because a group of employees believe they know best themselves. Thus, it is a cultural attitude that can unconsciously be encouraged in an enterprise or a group of employees, thus hindering the acceptance of external knowledge and thereby obstructing efficient knowledge dissemination.

4.2.5 BARRIERS RELATED TO THE CHARACTERISTICS OF SCIENTIFIC KNOWLEDGE

Another group of barriers occurs in relation to the type of knowledge created in universities. Some claim that 'a mental barrier' exists, as enterprises are prone to think that scientific knowledge is too advanced for them (Alves et al., 2007; Bearden et al., 1995; Muscio & Pozzali, 2013); that scientific knowledge is too general to be useful for enterprises (Gilsing et al., 2011); and too difficult to translate into practice (Alves et al., 2007; Gattringer et al., 2014). However, Baycan and Stough (2013) reference a study that shows how general scientific knowledge, techniques and methods are more important to enterprises than, for example, prototypes. Wang (2013) cites Perkmann and Walsh (2007) when suggesting that enterprises pay more attention to capacity-building and learning rather than tangible outcomes in the collaboration with universities. Hong, Heikkinen and Blomqvist (2010) stress that enterprises find applied research more valuable, whereas universities value basic research. This relates to the barrier about different expectations already mentioned in relation to 'cognitive and social distance'. The problem of basic science versus applied science is also illustrated in 'the black box' model by Ndonzuau, Pirnay and Surlemont (2002). The model shows that the path of transforming academic research results into economic value has numerous obstacles, difficulties, impediments, hindrances, and other sources of resistance (Ndonzuau et al., 2002). For enterprises, especially SMEs, it is risky to partake in such a process, since the outcome is indefinable. In total, this group of barriers indicates that there are characteristics to the scientific knowledge itself (as a product) that obstruct the dissemination process.

Another barrier in this category is differences in terminology. Universities often use an eclectic and speculative language, whereas the language of enterprises is more focused and practical (Alves et al., 2007; Gattringer et al., 2014; Ranga et al., 2008; Siontorou & Batzias, 2010). This can lead to misunderstandings and a lack of interest in interacting. Enterprises might simply give up, if terminology is too different from their own. On a related note, some review publications document how enterprises experience a lack of market orientation on the universities' part (Alves et al., 2007; Boehm & Hogan, 2013; Decter et al., 2007; Wang, 2013). This too is a barrier that points out that universities and their scientific knowledge product have difficulties complying with enterprises and their needs. Related to the classical gap, some conclude that the two parties simply lack understanding of each other (Bruneel et al., 2010; Ranga et al., 2008; Schofield, 2013; Siegel et al., 2003, 2004).

4.2.6 BARRIERS RELATED TO RIGHTS AND CONFIDENTIALITY

Questions on rights, confidentiality and IP (intellectual property) are often mentioned in the review publications as potential barriers to successful knowledge dissemination (Acworth, 2008; Alves et al., 2007; Ankrah & AL-Tabbaa, 2015; Barbosa & Romero, 2012; Bruneel et al., 2010; Liu et al., 2009; Muscio & Vallanti, 2014; Nielsen & Cappelen, 2014; Santoro & Bierly, 2006; Siegel et al., 2003; Szejko, 2002). However, it is mainly publications that address collaborative research projects between university and industry rather than knowledge dissemination more broadly. Thus, the impact of this barrier is not necessarily as large when it comes to a more general and mediated dissemination of knowledge between universities and SMEs.

Even a potential uncertainty about rights can cause conflict and keep enterprises from engaging in dissemination processes with the university (Acworth, 2008; Alves et al., 2007; Barbosa & Romero, 2012; Bruneel et al., 2010). This indicates that enterprises are aware that questions about rights and confidentiality exist and can be brought up, and that this alone can be discouraging to them. Imagine an SME with limited resources, who already feels that the university is too advanced and lacks market orientation. It is not hard to imagine that adding the idea of an extensive judicial account can be a significant barrier. A group of review publications points out that universities' inflexible insistence on IP can keep enterprises from getting involved in knowledge dissemination (Bruneel et al., 2010; Horng & Hsueh, 2005; Siegel et al., 2003, 2004). When interviewing different stakeholders, Siegel et al. (2003) found that enterprises repeatedly expressed their frustration at the university's lack of a 'dealmaking' mentality and aggressive tendencies in exercising their IP rights. By this, concluding that universities' procedures can be a barrier to efficient knowledge dissemination is not far-fetched.

Referencing earlier studies, Wang (2013) discusses the problems of IP specifically related to SMEs. It is suggested that enterprise size has an effect on collaboration, since large enterprises and SMEs have different IP policies to universities and industries. Large enterprises are more likely to jointly own patents applied by universities, and, as a result, universities are more likely to engage in patent management with SME partners rather than with large enterprises. Related to the earlier point about universities being more likely to engage with larger enterprises (Section 4.2.2), this adds to the need to focus specifically on SMEs when striving to optimise the dissemination of scientific knowledge. In this perspective, it is more demanding to disseminate scientific knowledge to SMEs, which is why new standards on how to do this are needed.

The focus on rights and confidentiality also relates to the question of trust, which is frequently brought up in this context (Abbasnejad et al., 2011; Alves et al., 2007; Boehm & Hogan, 2013; Bruneel et al., 2010; Massingham, 2015; Mora-Valentin et al., 2004; Nielsen & Cappelen, 2014; Philbin, 2012; Santoro & Bierly, 2006; Schofield, 2013; Sherwood & Covin, 2008; Wang & Liu, 2007). The importance of enterprises trusting the university prior to a collaboration or use of knowledge is stressed. The university must appear reliable and professional. On a similar note, both Ankrah et al. (2013) and Gilsing et al. (2011) stress that enterprises can experience a risk of loss of control and information leakage of the enterprises' technologies. This too implies that trust is an important factor in the dissemination of scientific knowledge between enterprise and university. Acworth (2008) and Mora-Valentin et al. (2004) find that the larger and more established the university in terms of experience, staff, finances and research funding, the greater the likelihood of knowledge dissemination. This shows that a university's brand and reputation is of importance. In relation to the thesis' research question (Section 1.6), it is relevant to consider how universities can be branded as a relevant external knowledge source to SMEs.

4.2.7 SUMMARY AND DISCUSSION

The six categories of barriers to dissemination of scientific knowledge between universities and enterprises (SMEs) have now been analysed. The analysis has resulted in a thorough understanding of the context and of the existing knowledge in the area of study. Summarising these understandings and assessing whether the character of a specific barrier is of relevance to the research question of the thesis (+) or not (-) is illustrated in Table 4.1. Note that some of the results mention SMEs particularly, while others regard enterprises on a general level. As mentioned earlier, I do not consider this a problem, rather a justification of the thesis' focus on SMEs. And since SMEs are a specific type of enterprise, the barriers also apply to them.

Category	(+)	(-)
The size and resources of the enterprise		SMEs have limited capacity and resources
	SMEs lack mechanisms (channels) for accessing knowledge from external sources	
		SMEs have less absorptive capacity than larger enterprises
	Enterprises can be unsure about the usefulness and quality of scientific knowledge	
Cognitive and social distance	University and enterprises have different expectations, interests and motives to engage in knowledge dissemination	
		University and industry have different cultures, experiences and different strengths and weaknesses
		Universities and enterprises have different time horizons
		The university takes too long publishing and commercialising their scientific knowledge
		SMEs are more likely to collaborate and access new knowledge within the same state/territory
Communication	A lack of communication from universities	
	It is often too difficult for enterprises to access scientific knowledge	
	SMEs relate most intensively to organisations close to them. Universities fall well outside SMEs' focus of attention	
	A lack of motivation to acquire external knowledge, which results in passivity (a lack of 'pull' from enterprises)	

	Enterprises experience a lack of convergence of interests and that scientific knowledge is not in sync with the needs of industry	
	Enterprises have a hard time identifying their own needs in relation to scientific knowledge	
	Enterprises have difficulties identifying competitive advantages of scientific knowledge	
	SMEs are less likely than large enterprises to initiate knowledge dissemination	
		The scientific community tends to be closed, leaving little room for external intervention
	The university lacks proper mechanisms to disseminate scientific knowledge	
	The lack of a functional interface or system for knowledge dissemination between university and enterprise is a central part of the problem	
	Universities are bad at marketing their scientific knowledge	
	Enterprises do not often know that scientific knowledge from universities is available to them	
Organisa-tional structure and culture		Organisational structures are only rarely flexible enough to absorb new technology
	Enterprises can reject external knowledge because they believe that they know best themselves	
The charac-teristics of scientific knowledge	Enterprises are prone to think that scientific knowledge is too advanced for them, too general to be useful for enterprises, and too difficult to translate into practice	

	Transforming scientific knowledge into economic value has numerous obstacles, difficulties, impediments, hindrances, and other sources of resistance	
	University and enterprise have different terminologies	
	Enterprises experience a lack of market orientation on the universities' part	
	Universities and enterprises lack understanding of each other	
Rights and confidentiality		Potential uncertainty about rights can cause conflict and keep enterprises from engaging in dissemination processes with the university
		The universities' inflexible insistence on IP can keep enterprises from involving themselves in knowledge dissemination
	The university must appear reliable and professional	

Table 4.1. Summarising and assessing the barriers

As Table 4.1 illustrates, a substantial number of the barriers can be solved by communication. For example, the fact that SMEs lack mechanisms (channels) for accessing knowledge from external sources is something that can be remedied by providing such mechanisms and creating awareness thereof. That SMEs have limited capacity and resources is not something to be changed, rather it is a fundamental circumstance of SMEs that must be understood and taken into account. By that, Table 4.1 serves as a summary of the review. It lists what must be overcome in order for the dissemination of scientific knowledge to SMEs using generic pathways to be successful. This list will be supplemented with empirical insights from Study B, and collectively this will serve as the foundation for the Development phase of the thesis.

Related to answering the research question of the thesis (Section 1.6), a couple of conclusions deserve an extra mention. First, it is now fair to say that there is great potential in making SMEs the specific target group of dissemination of scientific knowledge. The review has showed that SMEs, because of a lack of internal resources and small absorptive capacity, have not only a greater need for external knowledge but also tend to be more eager for external collaboration. Furthermore, it has been indicated that the most efficient knowledge dissemination happens between universities and larger enterprises. As a result, there is a need to optimise the dissemination to SMEs. Secondly, several of the barriers analysed in the review originate from university and industry having fundamentally different cultures and circumstances. An important understanding brought on by the review (see Section 4.2.2) and illustrated in Table 4.1 is that it is not automatically a question of overcoming these barriers; some of them are simply to be understood and taken into account. For example, the question is not how to improve the absorptive capacity of SMEs but rather how scientific knowledge is best disseminated to a target group with a great need (but poor ability) to find and use external scientific knowledge. Similarly, the goal is not to merge the cultures of universities and SMEs, rather it is to understand the difference and develop dissemination solutions that account for this understanding. On that note, a relevant point across review publications is that it must be easy for enterprises to access scientific knowledge and to get in contact with the university. The opinions about how to actually do that are more divided. However, the idea about an intermediary is essential and appears to be the means to overcoming several of these barriers. Creating the right intermediary is the challenge. Where existing literature primarily understands intermediaries as people, it is of the utmost relevance to this thesis to explore how a generic pathway can fulfil the role of an intermediary. The idea of a co-owned interface is a concrete example of this, and deserves more attention.

To conclude this review, I will make some reflections related to the second review question (RQ2): What designs and/or models for the dissemination of scientific knowledge between knowledge institution and enterprise are outlined by the publication? Knowing what I know now, what is then a good design or model for the dissemination of scientific knowledge between knowledge institution and enterprise? Up until now, the review has not provided concrete answers to this question. Some indications can, however, be found in the review publications. According to Baycan and Stough (2013), there are neither simple models nor simplistic solutions or mechanisms to ensure successful and efficient knowledge commercialisation. A relevant model requires a new understanding and vision as well as effective mechanisms to facilitate the commercialisation process. It must take into consideration the circumstances of the individual university (internal conditions as well as local and regional external conditions), its research strength and organisational capacity, the nature of the related regional industrial structure, and the broader social and cultural nature of the region. Similarly, Geuna and Muscio (2009) state that despite extensive evidence on what different institutions do when managing knowledge transfer, it is not possible to have a common formula for knowledge transfer institutions, i.e. universities. Furthermore, they argue that heterogeneity is not necessarily an advantage when it comes to knowledge transfer activities, seeing as one size does not fit all. Collectively, this indicates that a universal solution or model is not possible and not necessarily desirable. Baycan and Stough (2013) outline the prospects of commercialisation of knowledge, which effectively illustrates how the values and focus in knowledge dissemination activities have to shift in order to ensure its success. They conclude that a new mind-set has to emerge and that "the current focus on profit making, maximizing revenue, short-term benefits, tangible results of commercialization, and centralized structures could be shifted toward value making, maximizing the volume of innovation, long-term benefits, intangible results of commercialization, and decentralized structures". Related to the research aim of the thesis, an important understanding to take from this is to comprehend dissemination of scientific knowledge as not just profit-making, but also: value-making; as an open and decentralised innovation; with long-term benefits; that focusses on other forms of innovation, not just patenting and licensing; and which balances commercialisation with university identity. These understandings are in line with the research aim of the thesis and they add concrete indications as to what the development of new solutions should actually take into consideration. Dissemination of scientific knowledge requires a change of mentality, which is very much a communication problem to solve.

In conclusion, while there might be no universal model to the dissemination of scientific knowledge between universities and SMEs, and while the review publications do not provide a more accurate answer to what a good model might be, it is up to the thesis to provide further answers and insights on this account. How can we overcome the barriers now analysed? What situational factors must be taken into consideration? What is a good model for this specific type of communication? These are the next questions to be examined.

4.2.8 FINAL REMARKS

The literature review bears witness to a fragmented research discipline. The review has shown that publications addressing SMEs in particular are scarce. As already mentioned, only nine of the review publications actually address SMEs, which is saying a lot. I have also addressed the research methods of the review publications and illustrated how diverse they are (see Figure 4.1). Further, I have mentioned how it was insufficient to choose specific journals in which to conduct the literature search, because so many perspectives on the area of study exist and, consequently, relevant literature is found across disciplines and scientific traditions. The same goes for the journals they are published in. To exemplify, the 61 review publications are published in 47 different journals and proceedings. This indicates a lack of scientific tradition within the area of study. While there is some knowledge that appears to be commonly accepted, for example that limited capacity is a barrier to dissemination of scientific knowledge or that university and industry have different cultures, experiences, expectations and different strengths and weaknesses, the review publications often arrive at these conclusions independently. They do not cross-reference each other a lot. They appear to be fragmented scientific pieces from different disciplines, working mostly parallel to each other rather than building on each other's knowledge. For these reasons, I consider this literature review in itself an important contribution to the area of study.

CHAPTER 5: THE SITUATION OF SMEs RELATED TO (SCIENTIFIC) KNOWLEDGE

This chapter covers Study B and provides an answer to the second sub-question (SQ2): What characterises the situation of SMEs and their relation to (scientific) knowledge? As mentioned in Chapter 3, Study B is a qualitative study that explores SMEs' understandings, work procedures and overall situation in relation to (scientific) knowledge. While different types of data have been created for the study (see Section 3.3.2.2), the analysis will primarily be based the 37 semi-structured interviews (see Section 3.3.2.2.2), whereof eight are with CEOs and 29 are with employees from eight different SMEs. Transcripts of the interviews can be found in Appendix 2.4 – 2.40. The interview data will be used to conduct a cross-case thematic analysis, and the goal is to understand the situation of SMEs more broadly, which is also the reason for including SMEs of different sizes, trades and geographical locations in the study (see Table 3.1 for an overview of cases and their characteristics).

Please note that the interview data provides insights into how SMEs *experience* their situation (attitude) and not into whether or not they actually do what they say they do (action). For example, the interview data can show that a respondent experiences and articulates that he/she generally spends a lot of time finding new knowledge during a working day, but insights on whether or not that is actually the case are not provided by this data. While the go-along data is supplementary to the interview data, it is not used systematically in the study. The go-along data was created to get a sense of the physical surroundings in the SMEs, thus setting the scene for the following semi-structured interviews. By that, this data will not help distinguish attitude from action, because the it was structured around an introduction to the SME as a whole and not on observing the work processes of individual employees.

Based on the experiences and self-understandings of SMEs, the analysis will identify the context and circumstances that must be taken into account when disseminating scientific knowledge to SMEs. This will form the basis for discussing SMEs preferences regarding the dissemination of scientific knowledge. Furthermore, a goal of the analysis is to create and list some concrete communicative principles for the dissemination of scientific knowledge to SMEs. In the following analysis, such principles will be highlighted when they emerge, and at the end of the chapter they will be summarised, listed and explained.

Please note that parts of this study have been published in conference papers (Løkkegaard & Lykke, 2016; Lykke, Løkkegaard, & Jantzen, 2017b, 2017a).

5.1 CATEGORIES, THEMES AND CODES

As mentioned in Section 3.3.2.3, the analysis in Study B follows an inductive logic, which is an exploratory way of opening up a dataset. This means that the study is data-driven and that themes (categories of codes) and codes are identified semantically. By that, categories are created that describe general features of the data of relevance to the thesis' research question. The themes in this study initially originated in the interview questions, which were made from an immediate understanding of what insights were needed in order to answer the research question. This understanding came from literature, from reflecting on the research question and from my general engagement in the area of study. Accordingly, the themes were not created purely inductively from the data; rather they can be characterised as somewhat apriori (Gibson & Brown, 2009) as discussed in Section 3.3.2.3.3. Of course, they were not set in stone. During the data processing, they were refined, some were deleted, subthemes were created and all of them were renamed. However, the final themes did end up along the lines of the interview questions, which is not unexpected, since the interview questions do in fact represent the insights that the study empirically sought to provide. The codes, on the other hand, were created inductively and are all purely empirical. Creating them was an iterative process and included several iterations of reading through the transcripts and boiling down the pieces of data under each theme. By that, the codes represent the unknown, the experiences and self-understandings of SMEs, which are valuable to gain insights into, in order to answer the thesis' research question. Thus, the analytical task has been to identify codes, group them into themes and interpret them in relation to the sub-question of the study and ultimately in relation to the answer of the thesis' research question.

The themes created for this study can be divided into two categories: (1) Themes related to knowledge in general and (2) themes related to scientific knowledge in particular. Under each theme, a number of codes were identified. While some codes emerged across themes, others were unique to a single theme. However, all themes and codes included in the analysis capture something important about the data in relation to the research question (Section 1.6) and represent some level of patterned response or meaning within the data set. Table 5.1 summarises the themes and codes under each of these categories.

Category	Theme	Code
Knowledge in general	Channels to find new knowledge	Colleagues; Online searching; Business websites; Courses/further studies; External networks; Rival companies; News Media; Online forums; Social media; Previous projects; Newsletters; Scientific papers; Customer surveys; Educational books; Experts; Regulations/laws; Online knowledge banks; Watch services; Suppliers; Business magazines; Blogs; TED talks; Manufacturers; Google Analytics; Student Projects; Conferences
	Reasons to find new knowledge	Updating/upgrading of skills; Inspiration; Constant need for development; Find new solutions; Be first movers/at the forefront; Meet externally-imposed demands; Time- and resource-saving
	Barriers to new knowledge	Time/busyness; Business as usual/ "we know best"; Difficult to find/convert into something concrete; Expenses/resources; Too much material available; Difficult to share internally; Disturbing/noisy work environment; Has to come from management; Knowledge is outdated too quickly
Scientific knowledge in particular	SMEs' understanding of the university and 'scientific knowledge'	Good/interesting/usable; Students/education; Too theoretical/not practicable; Do not know; A resource; Not relevant; A closed world; Abstruse; Research centre
	Previous use of the university and how	Students; Research; Both
	Barriers to scientific knowledge	Ignorance; Too theoretical/specialised, not concrete/practicable; Closed world/difficult to access/contact; Time/busyness; Difficult to find/search for; Lack of communication/exposure; Not relevant to us/have no need for it; Overly long production time; Time- and resource-intensive; Overly heavy material/not result-oriented; Business as usual/"we know best"; Too much material available; Database difficult to use; Language barrier; Work with confidential knowledge; Has to come from management; Too bureaucratic/long-winded; Only has limited influence on collaborations

	Potentials to scientific knowledge	Access to new/useful/specialised knowledge; Talent development/recruitment; Inspiration; Product development/problem solving; Mutual profit; Time- and resource-saving; Credibility/backing; Students as a good/cost-effective resource; Neutral/unbiased knowledge; Be first movers/at the forefront
	How to contact the university	Searching for subjects specifically; Contact someone you know; Find a personal contact; Online search; The university website specifically

Table 5.1. Categories, themes and codes

As the following analysis will show, while some themes have also been identified and analysed in previous studies, others appear to be discovered for the first time in this study. By that, the contribution of this study is a cross-case and in-depth documentation of SMEs' experiences and self-understanding related to (scientific) knowledge. It provides a solution-oriented perspective on the area of study and uses the insights about circumstances, barriers and potentials (as identified by SMEs) to suggest how to communicatively improve the dissemination of scientific knowledge to SMEs. In order to make the contribution of this study clear, I will draw references to the Literature Study from Chapter 4 throughout the analysis.

5.2 REPRESENTATION OF DATA

In the following, I will present and analyse each of the themes and their codes. I will focus on making clear homogeneities, heterogeneities and relationships across the eight SMEs and the 37 interviews. The analysis will present data from the interviews in two ways. First, figures that statistically illustrate the codes under a theme are provided. Because the interviews were semi-structured and with open-ended questions (see Section 3.3.2.2.2 for reflections on the interview questions), not all respondents have answered all questions. For this reason, each of the figures will contain information about how many respondents it is based on and how many answers (n). The latter is necessary because the answer of one respondent often contains more than one code. Second, quotes will be used to elaborate on the more statistical information from the figures. The quotes are presented in order to illustrate the qualitative dimension to the answers and to exemplify articulations or different aspects of one or more codes.

5.3 THEMATIC ANALYSIS

While the main part of the analysis in this chapter will consist of a thematic analysis, the first analytical step is to explore how the respondents define knowledge. This is a focus I found relevant to prioritise prior to the thematic analysis in order to avoid predeterminations. Accordingly, the first part of the analysis will be structured a bit differently to the remaining analysis.

5.3.1 EXPLORING SMEs' UNDERSTANDING OF 'KNOWLEDGE'

To conduct a study on SMEs' situation related to knowledge, understanding their definition of knowledge was a necessary first step. As addressed in Chapter 2, there are several understandings and definitions of the concept of 'knowledge'. While I have defined the thesis' understanding hereof, SMEs do not necessarily subscribe to the same understanding. When creating data for the case studies, I purposely did not dictate my understanding of the term to the respondents; instead I asked them openly what they understood as 'knowledge' in relation to their work. Prior to the creation of interview data, I assumed that SMEs would be most likely not to have read any theoretical discussions of the term, and that they quite possibly would not have explicitly considered their own understanding of it. I expected that many respondents would have difficulties answering this question, because they would not have articulated this understanding to themselves or to others before. From this perspective, I anticipated that I would have to 'force' them to come up with an answer to the question, by which the answers could be somewhat unreflective. However, to ensure a common understanding on which to found the remaining questions, it was necessary to ask anyway. Accordingly, I asked all respondents the question: "What is knowledge to you in relation to your work?" While most respondents needed a minute to think about it, the answers were surprisingly similar and featured several commonalities, which indicated that it was not as unreflective as I expected.

The respondents articulated different types of knowledge in relation to their work. First, knowing how to perform a task or a job-related problem was evident to them:

"Knowledge is to be able to handle, to understand, to construct buildings that are legally okay. That is knowledge to me. To have that knowledge in order to know how to do it."	Respondent 6
"In a workday, knowledge to me is especially characterised by what I have tried before and what I know works."	Respondent 13
"The knowledge I have is project management itself, how to handle the client, how to interact with the team and the client."	Respondent 24

To 'know how' to handle something in everyday work situations is a basic and necessary kind of knowledge, according to the respondents. Another type of knowledge that can be identified in the data is a more technical (theoretical) knowledge:

"It is a bit diffuse to me of course. But knowledge is of course both regarding legislations, that I know them. We have some rules depending on how we act, both regarding the documents we produce and also regarding pension; there is legislation about that. So, it is of course to know these legislations, that is knowledge to me."	Respondent 26
"Knowledge is of course knowledge about our credit policy of the bank, which is thoroughly described. There is knowledge you have on your backbone to act on when clients want loans and credit, then we know what the bank's policy is. Prices, knowledge on prices, fees and rates of interest."	Respondent 29
"I would say that the pure technical, that is the type of knowledge that we are most focussed on in my trade group. It is the technical knowledge like law, techniques for constructing architecture and all that lead a house or a construction to function."	Respondent B

These quotes exemplify the respondents' articulations about a technical knowledge; Respondent B even explicitly names it. The technical knowledge relates to 'knowing that' something is the case or having 'knowledge about' something, e.g. the market; consumer behaviour; theories; credit policies; rules and regulations; prices; technologies; or competitors. By that, two aspects of knowledge are identified in SMEs' articulations. These echo Ryles' (1949) classical distinction between 'knowing how' and 'knowing that', which was addressed in Chapter 2: We can learn *that* a rule exists and we can learn *how* to act in correspondence with that rule. 'Knowing how' can be measured by certain standards of success or failure; we can know how to construct architecture *well* or we can know how to *successfully* talk to clients. At the same time, know-how is often more abstract and difficult to put into words. On the contrary, 'knowing that' is the knowledge you can read about; it is an explicit knowledge (Polanyi, 1958) or encoded knowledge (Blackler, 1995), which means it can be codified and transmitted because it is captured in records (documents and files). Of course, it is difficult to separate these two aspects of knowledge completely. Polanyi (1966) stated that 'knowing that' and 'knowing how' collectively amounts to 'knowing', by which it is also made clear that a definitive distinction should not be made. This goes for the data as well: The respondents' articulations cannot definitively be characterised as 'know how' or 'know that'. The following quote exemplifies this:

"If you look at it isolated here in our department then it is knowledge about the market, it is knowledge about our client base. Where are they going, what triggers them? And also about our rivals; knowledge about what happens in the city; how do other cultural institutions react?"	Respondent 15

For example, knowledge about a client base can be both know-that (you can read about trends and tendencies) and know-how (you can know from previous assignments what these clients tend to prefer). But this example does underscore that 'knowing how' appears to be mainly experience-based (practical), whereas 'knowing that' appears to more theory-based (technical). I asked the respondents where they get their knowledge from, and their answers illustrate this distinction between experience-based knowledge and technical knowledge:

"I have it from my education, but then I also have it just because I know the customers. It is a large knowledge about customers and when you have so different customers then you have some knowledge you can bring from one to the other."	Respondent 4
"You take a very short education and then you build on top of it and gain experience. And you use your experience just as much as what you learned as a newly qualified many years ago."	Respondent 5
"I have it from education to begin with, but mostly it is to learn it yourself, to update it every day because the world is constantly changing."	Respondent 11
"It is both based on experience but also partly on theory, I would say."	Respondent 13
"Of course, the knowledge I have from back when I finished my education, I use it unconsciously but it is not the knowledge I use on a daily basis. That is more experience and knowledge about how the business works … But of course, the knowledge I have back from school is in the back of my head."	Respondent 25
"It comes from education, it comes from experience, it comes from storage of things you think might be useable later on."	Respondent 28
"A lot of it is experience we have gained along the way. Of course, it also comes from a combination of all our educations, which we then match. In that instant, it is quite okay that we are as different as we are, that we have both IT people and communications people and humanists that we then mix together, and then of course some practical experience."	Respondent C

As these quotes illustrate, two main codes can be identified in the data regarding the origin of knowledge: (1) Education, which covers education, courses and theory; and (2) Experience, which covers practical experience. A third, less-mentioned code is knowledge being (3) Self-taught, which covers reading documents and searching online on your own. This, however, could arguably be a sub-code to 'Experience'. The following figure statistically presents all answers to the question about where knowledge comes from.

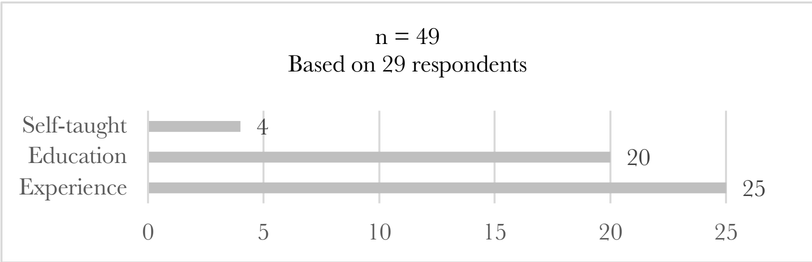

Figure 5.1. Where knowledge comes from

As the figure shows, the respondents identify 'Experience' as the main origin of knowledge. The following quotes exemplify this code:

"We really use what we have already made a lot. We do not have to make things more difficult than necessary. Drawing houses is experience and reuse, of course it is."	Respondent 5
"I often think that knowledge to solve the assignments here, that it is something you build up and you get better at for each time because "oh, now I made that mistake", but then when it gets tested, someone says that this and this might be better, and then you know it for next time."	Respondent 10
"I think that it is mainly about having experience with the processes, like how it works best and how it is connected."	Respondent 16
"Knowledge is, it is mainly experience, I think. Experiences I have my-self, experiences people around me have. Knowledge about how to get to a solution the easiest."	Respondent 25
"… our understanding of our customers' market, that we can say "Lis-ten, you might come and say that it has to work in this and that way, but our experience shows that we have to do this instead". And that is where we can really contribute with some value to our customers."	Respondent G

As the quotes show, 'knowing how' appears to be mainly experience-based to SMEs, seeing as it is knowledge of their procedures, of how to solve their tasks, of what works and what does not work, of how to talk to clients and so on. On the contrary, while 'knowing that' can also be experience-based, it appears to be primarily technical and comes from educational background – from courses, manuals or literature. The quotes above also indicate that to SMEs, experience *is* knowledge. Or the other way around: Knowledge *is* experience. It indicates that knowledge is very important to SMEs, which also becomes evident through the interviews:

"Yes, that we are at the forefront and continue to be the best. They (clients, *red.*) cannot be able to do it themselves. It is important that we constantly prove that we are one step ahead and have a knowledge that they do not."	Respondent 9
"I constantly think that it is about ensuring that we are up to date. If we do not have that knowledge, then we cannot give our clients proper counselling. I think it is fuel to our business. If we do not have that knowledge, we cannot run our business because we essentially make a living out of selling our knowledge."	Respondent 12
"Knowledge is something we constantly need and something we need to share with each other, something we need in order to make everyone understand what our client wants and what our client really needs."	Respondent A

That knowledge is "fuel to their business" is an articulation that gives a good illustration of knowledges' importance to SMEs. SMEs *need* knowledge in order to run their business (to develop their products and to stay updated and relevant). Accordingly, they need knowledge to justify their existence. The fact that they articulated that knowledge is of great value to them and that they strive to be constantly updated bears witness to an explicit awareness, which can be beneficial to the research aim of this thesis.

This analysis has contributed with perspectives on SMEs' definition and experienced use of knowledge. The distinction between experience-based and technical knowledge adds to existing literature in that it illustrates what type of knowledge SMEs find relevant and why. Further, that SMEs actually (and explicitly) find knowledge essential in order to run their business and justify their existence adds a perspective on their self-understanding related to knowledge. It indicates that the research aim of this thesis is valid and that it could potentially create value for not only the university but also for SMEs.

5.3.2 CHANNELS TO FIND NEW KNOWLEDGE

To understand the knowledge seeking behaviour of SMEs, I explored how, where and when respondents search for new knowledge. To gain these insights, I asked the following questions: "What sources and tools do you use in your current work?"; "Do you ever look for new knowledge, and if so, in what situations?"; "What do you do if you get an assignment you do not know how to solve?"; "Where have you previously searched for new knowledge related to your work?" and "Why did you search there?"; "What do you think about searching for new knowledge, i.e. do you find it fun, annoying, stressful, inspiring?"; and "In your opinion, is searching for new knowledge prioritised in this enterprise?". I am aware that there is an entire research area of Information Science that engages in the study of knowledge-seeking behaviour and practice, also specifically for enterprises and SMEs. However, because this study focusses on understanding the *situation* that SMEs are in, in relation to (scientific) knowledge, rather than SMEs' information *need*, I will not draw parallels to that scientific tradition. There are, however, similarities and differences, but this thesis refrains from going into the scientific discipline of Information Science.

The questions asked for this analysis initially created three themes: (1) Searching for new knowledge: Where; (2) Searching for new knowledge: How; and (3) Searching for new knowledge; When. However, as the analytical iterations on creating codes and themes from the data came along, the third theme was deleted due to a lack of relevance, and in the next iteration I ended up merging the first and second theme. It was simply too 'forced' to keep them separated, as they were deeply connected and interdependent. Accordingly, the merged theme was called: Searching for new knowledge: How and where. Working on refining the codes made it possible to reduce the theme even further. The answers could essentially be boiled down to what channels SMEs used to find knowledge. Under this theme, several codes were identified. Figure 5.2 provides a statistical overview of the created codes.

As the figure shows, 'Colleagues' and 'Online searching' were by far the most common channels used to acquire new knowledge. Referring to 'Colleagues' was mentioned a little more than 'Online searching', which can be said to reflect several characteristics. First, it implied that SMEs prefer to access knowledge through a relational pathway. The mention of 'External networks', 'Rival companies' and 'Experts' also pointed to this. Second, it implied that SMEs prefer knowledge that is experience-based and person-dependent, which was addressed in the previous section as well. Third, it points to the fact that employees in SMEs are accustomed to working closely together to solve problems, which is a consequence of the smaller number of employees in this type of enterprise. Fourth, asking a colleague is a quick and cost-effective way of learning something new and solving a problem. It points to a need for the solution to come immediately, be cost-effective – preferably free of charge – and to be quickly practicable, which relates to the general lack of resources in this type of enterprise, which was addressed thoroughly in the Literature Study in Chapter 4. Fifth, asking a colleague can be said to nurture a habitual way of thinking and working and as a consequence a 'we know best ourselves' men-

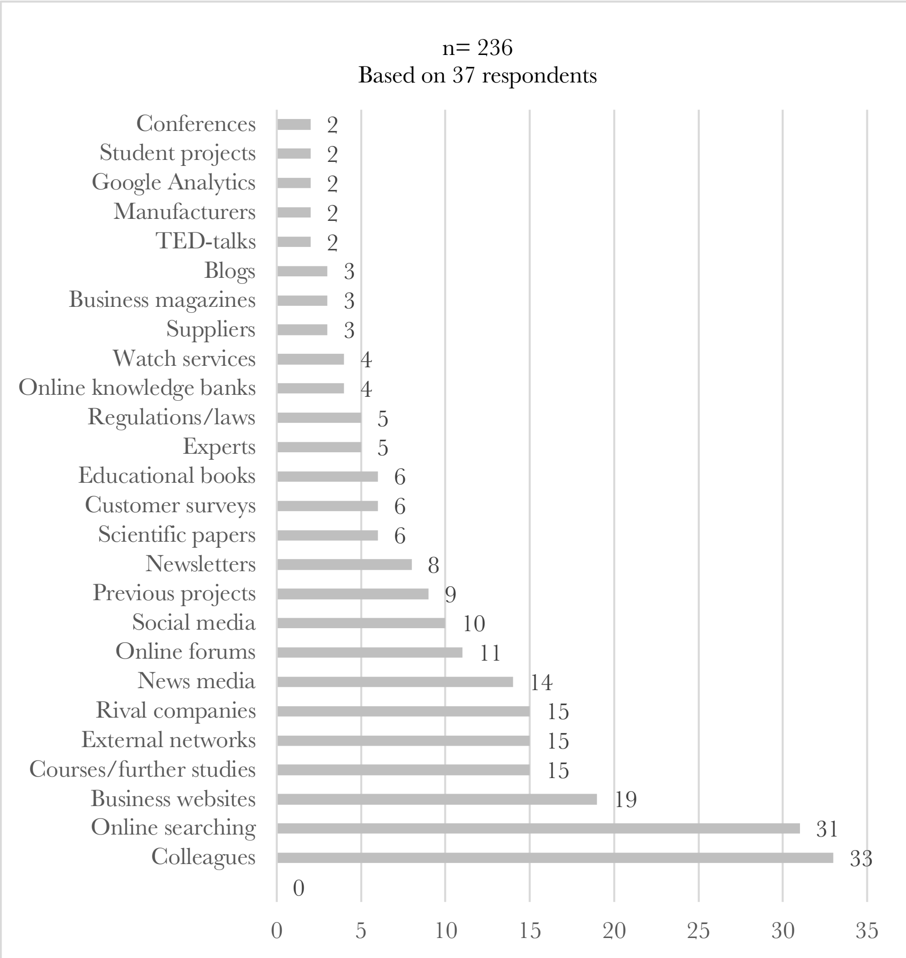

Figure 5.2. Channels to find new knowledge

tality can occur. This is what was labelled the 'not invented here-syndrome' (Baltes, 2000; Bearden et al., 1995; Decter et al., 2007; Sher et al., 2011) in the Literature Study, and which covered a tendency to reject external knowledge because a group of employees can believe that they know best themselves and could not gain from external knowledge. Collectively, the frequent mention of 'Colleagues' as a preferred channel to acquire new knowledge can be interpreted as SMEs being accustomed to finding the answer amongst themselves, which could make it difficult to disseminate external knowledge to them.

However, respondents mentioned 'Online searching' nearly as frequently as 'Colleagues'. Contrary to what I just stated, this implies that SMEs are in fact oriented towards searching outside of the enterprise for new knowledge. Furthermore, 'Online Searching' is an example of a generic pathway, by which the personal relation (relational pathway) appears to not be entirely evident to SMEs' search for new knowledge. However, what 'Online searching' has in common with 'Colleagues' is that it also points to a need for knowledge to be quickly accessible and inexpensive. Further, using 'Online searching' can result in different types of knowledge being found.

"I can be directed to The Danish Building Research Institute here in Aalborg. I can go to the webpage of the Danish Business Authority. It is mainly such pages I use when I Google things."	Respondent 6
"Well, Google is amazing. It is a bit random. But otherwise there is borger.dk where you can find a lot of information that we need in our world."	Respondent 26
"In the old days, we had hand books and all sorts of other things, today the internet is a goldmine of data, it is a large inspirational source, both regarding architecture and regarding problem solving."	Respondent B
"We typically read it at something called Montell, which is a pan European energy news portal. Here at home something is called EnergyWatch and they have also become really competent. Those journalists have become really good in just one year. And then you can go to the European Union's website or the Parliament, if it is Danish politics. The Danish Energy Agency or energinet.dk."	Respondent F

As the quotes show, online searching for technical knowledge (know that) is very common. It covers searches for rules and regulations in particular. Online searching for experience-based knowledge (know how) is equally used:

"Mostly I just Google it. There is something called Facebook Developers and then there is something called Facebook for Business. They have some good articles about what happens and it is often those that appear when I search. Otherwise I just enter some debate forum."	Respondent 9
"I can look at how others have solved something similar and then maybe I can do that but add some percentages to it. Often it is a collaboration with others where they ensure to share something, it primarily takes place online. So, it is a question about skimming through a lot of forums and find out what others have done."	Respondent 11
"In my search for knowledge it is primarily larger, known sites with plenty of examples on how to do things that suits me best (…) There are many TED talks that are relevant for what we do."	Respondent 21

"It is often Master Google. But then sometimes you can specifically go to that PMI Society and ask questions too, I am also a member of something called a Chapter on the PMI Society, and that is the Denmark Chapter and there I can ask questions. But there are also plenty of other forums."	Respondent 24

Searching for experience-based knowledge means searching for inspiration, what others have done before you, and so on. As Figure 5.2 shows, 'Business websites', 'External networks', 'Rival companies', 'Online forums', 'Social media', 'Previous projects', 'Online knowledge banks', 'Suppliers', 'Business magazines' and 'Blogs' all indicate an orientation toward experience-based knowledge. Further, several of these codes, i.e. 'Business websites', 'Online forums' and 'Social media' indicate an orientation toward ad-hoc knowledge that provides ideas and inspiration specific to market and business, of which the quote above from Respondent 24 is a concrete example. The latter, that knowledge has to be specific to the market and business of the SME, appears to be a central and general characteristic for the knowledge-seeking behaviour of SMEs. It points to a communication principle about the providing of scientific knowledge: According to the preferences of SMEs, scientific knowledge should be provided where they already look for knowledge. The mention of "Courses and further studies", which also figures relatively high in Figure 5.2 also bears witness to the aforementioned need for knowledge to be subject-specific and further indicates an orientation toward intensive training in a chosen and relevant subject.

'Online searching' is a very broad code and, actually, several of the other codes can be said to be sub-codes to it. That goes for 'Business websites', 'News media', 'Online forums', 'Social media', 'Online knowledge banks', 'Blogs', 'TED talks' and 'Google analytics'. At the same time, 'Previous project', 'Scientific papers' and 'Customer surveys' can also be said to be part of this code, seeing as these types of knowledge often appear in online searches. In conclusion, a main code for all of these sub-codes can be 'Digital information channels' and it would, accordingly, be the code mentioned most times and, as a result, it would be the channel used most frequently by SMEs. What all of these (sub)codes have in common is that they are generic pathways. Regarding the communication principle mentioned above, this points to the provision of knowledge through generic pathways being in line with SMEs' preferences. From the analysis, it can be concluded that using generic pathways is not foreign to SMEs. Using generic pathways to find scientific knowledge particularly, which can be labelled a specific type of technical knowledge, however, is only rarely mentioned by the respondents:

"I would go and search online to see if I could find some scientific papers. I actually do that sometimes."	Respondent 5
"It could be at the website of Aalborg University, it could be at MIT's webpage. Or if it is economic theory, it could be Stanford or Harvard."	Respondent F

Here a potential for improvement exists. Related to this, an interesting observation is that several of the generic pathways mentioned by the respondents in some way or another contain a relational pathway. For example, 'Online forums', 'Social media' and 'TED talks' are generic pathways that disseminate knowledge using a relational feature. Compared to existing literature, e.g. de Zubielqui et al. (2015), who conclude that SMEs prefer to use generic pathways, this analysis now contributes with an expanded understanding of SMEs being oriented towards generic pathways where features of relational pathways are implemented. Accordingly, multimodality appears to be a preferred option, which has also been pointed out by Bielak et al. (2008) and referred to in Section 2.2.4.

In conclusion, using colleagues and a diverse list of digital information channels (generic pathways) appear to be characteristic of SMEs' knowledge-seeking behaviour. In line with existing literature, this analysis has shown that using generic pathways is not foreign to SMEs, which is of relevance to the research question of the thesis. However, this analysis also adds to existing research in that it outlines the diverse types of channels used by SMEs to find knowledge. The perspectives on using colleagues and online searches respectively elaborates on SMEs' preferences when engaging in finding new knowledge. Another contribution of this analysis is the advancement of some characteristics about the knowledge product that SMEs request: Knowledge must be easily and quickly accessible, personalised, experience-based and specific (according to the business or market area), and cost-effective (due to a lack of resources); providing both 'know how' and 'know that'; and experimenting with incorporating relational pathways (or features thereof) into a generic pathway. This points to a communicative principle about how scientific knowledge should be organised – or reorganised – according to SMEs.

5.3.3 REASONS TO FIND NEW KNOWLEDGE

The data allows for an exploration of SMEs' incentives for searching for new knowledge. By that, identifying the potentials that SMEs ascribe to new knowledge (and why) is made possible. While I did not explicitly ask the respondents why they look for new knowledge, a clear pattern could be identified from the respondent's articulations. SMEs primarily look for new knowledge for one of two reasons: (1) When they have to solve a pressing problem or task, thus looking for precise information or (2) when their task is to update their knowledge and to gain inspiration by looking for new ideas, technologies, processes and products. These two reasons can be labelled 'purposeful search' and 'inspirational search' and were expressed in a number of codes, which are illustrated in the following figure.

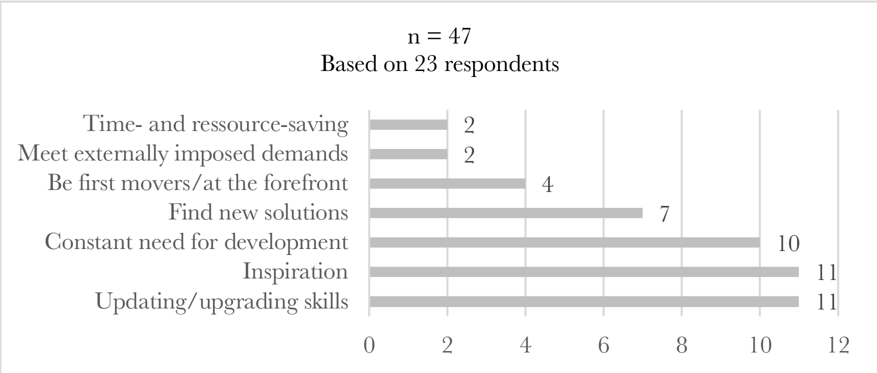

Figure 5.3. Reasons to find new knowledge

In relation to solving a specific and pressing job-related problem, one reason for searching for knowledge mentioned by SMEs was to 'Update or upgrade skills'. On a similar note, new knowledge makes it possible to live up to the 'Constant need for development', which SMEs experienced. The respondents also articulated to 'Find new solutions', 'To meet externally-imposed demands' and to 'Be first movers/at the forefront' as reasons for finding new knowledge. All these codes are somewhat related. They all address a need to be constantly evolving and to constantly justify ones' existence. To be relevant, SMEs must continuously update their skills, develop themselves, find new ways to solve things and be at the forefront. To do this, finding new knowledge is extremely valuable to them:

"We make our living on selling our knowledge, so we have to constantly develop it. Otherwise, we cannot continue to sell it."	Respondent 1
"It is a world that is constantly moving. The way it is today is not the way it was yesterday, and it will not look that way tomorrow either. So, it is a process of continuously allocating an amount of time for knowledge development to gain new knowledge and find out how to actually use it in practice."	Respondent 11
"Besides living in a world that is constantly changing it is also relatively new; it is the energy market which was liberalised not so many years ago. Compared to banks that have been here for hundreds of years and who	Respondent 20

have slowly organised themselves, we are building things from scratch, we are in the middle of it and we have to act now.”	
“But again, because we develop new solutions from time to time, we have to find new things. It is not just routine work from day to day so we have to find new solutions to the things we have.”	Respondent 22
“But as a rule, it is important. We cannot even operate in the market if we are not at the forefront, because things are going so fast.”	Respondent C

These quotes bear witness to SMEs being not just under constant time and resource pressure, which is commonly addressed in the existing literature (see Section 4.2.1); this study has now shown that they are also under a constant development pressure. This is an important understanding and a new contribution compared to the existing literature. The situation of SMEs is that they, through a constant development of ideas, products and solutions, continuously have to justify their existence. Accepting this leads to specifying why SMEs identify a great potential in accessing new knowledge. By that, this study has contributed with perspectives on SMEs' reasons for searching for new knowledge and their ways of using it. Accordingly, it can be concluded that scientific knowledge can in fact be of relevance and value to SMEs if disseminated properly.

Another reason to search for new knowledge was to find ‘Inspiration’. While there are other reasons related to solving a specific and pressing job-related task, finding ‘Inspiration’ was a more general endeavour:

“Then you use some things and go different places to examine them a bit. What possibilities exist in the market? Because architects sometimes get some crazy ideas and then you have to find out what exists.”	Respondent 5
“Sometimes I get some knowledge that is a bit, well, I sometimes get an eye-opening experience about things I did not know existed, actually just by clicking things I did not plan for and then sitting down and looking at it.”	Respondent 11
“I find inspiration because it is also a large part of my role that I gain new knowledge so that we can be at the forefront and share it on courses and presentations.”	Respondent 12
“Sometimes it can be healthy to look outside the four walls or how many walls there are and see how other people do it and then get some inputs that way. Sometimes that can be quite inspiring.”	Respondent 25

As these quotes show, SMEs also found it profitable to look for knowledge as inspiration. However, although it is not related to solving a specific and pressing task, it always had a job-related purpose: To find out what can possibly be done, to get ideas for new methods and products, to update knowledge that can be used more generally to keep the enterprise going and to renew the enterprise. While this was mentioned frequently by respondents, they also mentioned that this 'inspirational search' was not often realised because of a lack of time for it, which will be elaborated on in the analysis of the next theme. Nevertheless, the fact that respondents mentioned it can be understood as an identification of it being potentially lucrative; they would like to do it more, if their situation allowed for it. This insight points out that according to SMEs' situation, presenting knowledge in a way that allows for an 'inspirational search' and 'being inspired' could be profitable. This understanding adds to the existing literature. To focus on inspiring SMEs could be a new way of approaching them and understanding their preferences. This also points out something related to the previously-mentioned communicative principle on reorganising knowledge. A quality to play on in order to inspire them could be that it can be 'Time and resource saving', which was also mentioned by a couple of respondents:

"I am probably a searching type and I sometimes invest half a day in developing the right type of shading. And then the point is that over time it is supposed to save time."	Respondent 6

This entire thematic focus on the potentials that SMEs identify related to finding and using new knowledge provided a new perspective compared to existing literature. The fact that the systematic review in the Literature Study in Chapter 4 ended up mainly addressing barriers and problems in the dissemination of scientific knowledge between knowledge institution and enterprise bears witness to this. Although the review questions (see Section 4.1.1) asked about models and experiences related to knowledge dissemination, the review ended up being structured around barriers. This bears witness to this area of study generally being most focussed on barriers (disclosing and solving them), which indeed is addressed quite often in the existing literature. By that, this analysis contributes to the area of study with new perspectives on the *possibilities* (as identified by SMEs themselves) rather than the *barriers*.

5.3.4 BARRIERS TO NEW KNOWLEDGE

A theme about 'Barriers to new knowledge' was identified in the data. Although I did not ask the respondents explicitly about this (I asked them if they ever search for new knowledge just for the sake for it), it was a central topic in all interviews. I believe the reason for this was that because the goal of the interviews was to outlay the overall situation of SMEs in relation to knowledge, several of the questions encouraged the respondents to talk openly about the situation of their enterprise and the context of their everyday work. The results of this can often be related (and interpreted) to both barriers and potentials related to accessing external knowledge.

The codes to the theme of 'Barriers to knowledge' are illustrated in the following figure. Like in the Literature Study and especially Table 4.1, which summarised and assessed the barriers mentioned in the existing literature, the barriers mentioned in this empirical study can be assessed according to whether their character allows them to be solved by insights provided by this thesis or not. That is, if they can be solved with communication or not. Accordingly, the codes illustrated in Figure 5.4 can be divided into two categories: (1) Barriers that can potentially be solved with communication and (2) barriers related to the fundamental situation of SMEs that cannot be changed by insights provided by this thesis but must be understood and taken into account.

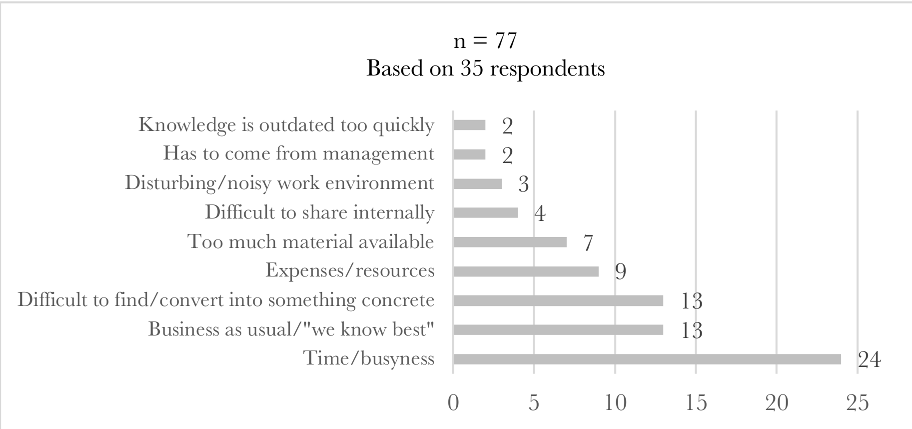

Figure 5.4. Barriers to knowledge

The barriers related to the fundamental situation of SMEs and which are not to be solved by insights provided by this thesis include 'Time/busyness', 'Expenses/resources', 'Disturbing/noisy work environment', 'Has to come from management' and 'Knowledge is outdated too quickly'.

'Time/busyness' is the first barrier that cannot be changed with communication. It is also by far the most dominant code in relation to this theme. Figure 5.4 clearly illustrates that lacking time and being busy was a fundamental condition for SMEs and that it, quite naturally, affected their knowledge-seeking behaviour. This was also addressed in the Literature Study and, accordingly, it is a well-known barrier in the existing literature. However, the empirical data in this study provides new insights on a qualitative exploration of SMEs' experiences in this regard.

"If I had time, I would study semiotics, but of course, I do not, because I work very, very much. Actually, I am not ever really off."	Respondent 2
"I guess it is also the time. We just work on and on. It is not like we have a lot of time to sit and reflect on things. It is cut to the chase all the time."	Respondent 5
"But it is really difficult for us to take out half a day because we have deadlines. If we have 12 clients then we have 12 deadlines, they need something on their Facebook-page every day, so we have deadlines every day. So, taking a half day out of the calendar is actually a lot."	Respondent 9
"This is a season-dependent enterprise and right now we just do not have time for anything at all."	Respondent 13
"I have to develop some new concepts, when time will allow for it sometime. Right now, we do not have time, we run at 550 kilometres per hour so we simply do not have time to go into that (…) Time is very, very limited."	Respondent 17
"I rarely have time for it at work. Then, it is called free time. Interested free time."	Respondent 24

It is a recurring fact that the employees in SMEs experience being busy. It has the effect that SMEs only search for new knowledge when a specific and pressing problem has to be solved. Although several respondents expressed a desire to spend more time on updating their knowledge and finding inspiration for future solutions, searching for knowledge without a specific goal in mind is deselected due to a lack of time. It relates to another barrier, 'Expenses and resources', both of which are scarcer among SMEs than among larger enterprises, also addressed frequently by the existing literature, see Section 4.2.1. These conditions cannot be changed with communication. However, taking these circumstances into account, it is learned that, in order to appear relevant to SMEs, knowledge must be disseminated and presented in a way where how to use it is quickly identifiable in order to solve specific work-related problems. This introduces a communicative principle on <u>concretising</u> knowledge, which I will get back to.

Another set of barriers to take into account rather than to change were a 'Disturbing/noisy work environment' and that knowledge 'Has to come from management'. That 'Knowledge is outdated too quickly' witnessed the speed at which SMEs operate; they constantly have to update their knowledge to remain relevant:

"There is not a lot of theory on our field. And that has been one of the major challenges I think in the entire academic world that a lot of the existing theory is outdated again almost before it has been launched because then there is something else that works."	Respondent C
"If you spend a lot of time codifying your knowledge then sometimes it will be outdated before you manage to finish it. Especially within our market and our technologies."	Respondent G

This is a central characteristic regarding the scientific knowledge itself, which was also addressed in the Literature Study. That universities take too long publishing and commercialising their scientific knowledge (Hansotia, 2003; Lakpetch & Lorsuwannarat, 2012; Vaidya & Charkha, 2008; Yusuf, 2008) can cause SMEs to automatically opt out of scientific knowledge because it is incompatible with their short-termed goals. This barrier is very central and requires a solution. However, it requires a change in the procedures and methods in the scientific world, which is not an easy task and cannot be solved by insights provided by this thesis. Within this thesis, this understanding serves as a condition to be aware of. How a generic pathway can or cannot take this condition into account will be discussed in the Development phase of the thesis.

Regarding the barriers that *can* potentially be solved with a new dissemination pathway is the frequently-mentioned barrier that knowledge is 'Difficult to find/convert into something concrete'. It bears witness to the characteristics of scientific knowledge being too general to be useful for enterprises (Gilsing et al., 2011) and too difficult to translate into practice (Alves et al., 2007; Gattringer et al., 2014), which was addressed in the Literature Study. The following quotes exemplify some of the respondents' experiences in this regard:

"Knowledge, to me, is useless if I do not know how to transform it into something solution-oriented. If I were to sit down and read a book about some piece of advanced technology or whatever, that knowledge would be worth nothing to me if I did not know that I would somehow be able to convert it or use it. Then, it is useless to me. I have often read something that has turned out to be a waste of time because I never found out how to use it. So, I could spend a lot of time and a lot of wasted time on gaining knowledge, but it would be wasted knowledge because I would not use it. I would not convert it."	Respondent 11
"I think I would notice it if it is on P1 (radio channel, *red.*) in the morning, there is often something up and then it stays in the back of my head. But it is difficult to convert because it is general, and everything general about marketing is good for inspiration but it is useless in practice because there	Respondent 15

will always be a lot of limitations. So, you can say that this method is brilliant but in our specific case there will be a lot of exceptions. So, when it comes to that it is really difficult to convert one-to-one for us."	

That knowledge is useless if it cannot be transformed into something solutions-oriented is an incisive description of SMEs' experiences on this account and adds to the communicative principle on concretising mentioned above. It points out that it must be easier for SMEs to find knowledge and to convert it into solving their job-related problems. One respondent explains this barrier of it being hard to know what one needs to know:

"Sometimes, it can be difficult to gain access to that knowledge because if I do not know what I need to know, then it is difficult to find it, but I guess that is a traditional problem for many, I think: if you knew it, why then look for it? Then, it might be that sometimes, I have to create some knowledge others may have created before. I simply do not know that they did."	Respondent 11

This quote indicates that SMEs cannot be expected to sit down and search (browse) for something if they do not know it exists. That they lack time and resources enhances this; they need the solution to appear quickly and to be directly implementable to their work processes. Browsing aimlessly is neither efficient nor does it necessarily result in something usable. This can be a reason for why SMEs frequently use 'Colleagues' as a channel to new knowledge and why they say that they often find a solution amongst themselves. It is not only quick and cost-effective, it is also 'guaranteed' that a solution will be found. Searching (browsing) for something you do not know about or how to convert into something concrete lacks this guarantee.

A related barrier identified by SMEs is that 'Too much material is available'. The identification of this code bears witness to online knowledge not necessarily being organised in a way that makes sense to SMEs. This indicates that in order for SMEs to find and use knowledge, they must be immediately able to decode where to find it, how to use it and thus how to concretise it. The profits of using it must be immediately recognisable, otherwise SMEs will de-select it. Again, this relates to the communicative principle on concretising.

The 'Business as usual/ "we know best"' barrier figures again. It appears to be a central characteristic to the situation of SMEs – possibly as a consequence of the time pressure – that they follow the procedures they are accustomed to.

"I search for what I know and what I know to be good. Otherwise, I use my network and call someone and say 'I need this, do you know something good?' I cannot find that online, I think."	Respondent 14
"People who have been on the job market for many years might tend to forget because they have so much experience so they think it is just functioning."	Respondent 16
"I think that is one of our challenges, that we very much have a blind faith in the notion that we know best ourselves."	Respondent G

These quotes show that SMEs are explicitly aware of their routine-based use of knowledge, i.e. that they 'search for what they know is good'. It can be interpreted as SMEs not needing new knowledge, and as Respondent G states, they are aware that it is a challenge. Further, some respondents articulate a 'pride' that must be overcome in order to exploit the full potential of external knowledge:

"It is about putting your pride on hold and gain the knowledge from those who know more than you do."	Respondent E
"It is like, arh, you do not want to ask because you do not want to show that there is something you do not know."	Respondent H

Collectively, this results in a resistance to change and to acquire external knowledge. If this is to be overcome, the 'we know best ourselves' mentality should be diminished, which means that SMEs must see that other knowledge sources can also be helpful to them. The final barrier mentioned here is that knowledge is 'Difficult to share internally'. While this can be said to be a fundamental circumstance for SMEs, it bears witness to SMEs requesting knowledge that can be shared with colleagues. By that, it is also something that can be changed with communication by providing features for how to share knowledge with colleagues.

This analysis has confirmed several findings from the Literature Study, i.e. that SMEs lack time and experience being busy; that they lack expenses and resources; and that they sometimes feel they know best themselves. Furthermore, the quotes in this analysis – for example the one from Respondent G saying that "that is one of our challenges" – also show that SMEs are aware of this potentially being a problem and, accordingly, there is a need to diminish this attitude. Other new perspectives on SMEs' situation have also been provided, for example that SMEs find it difficult to share knowledge internally, that their work environment is disturbing or noisy, and that knowledge has to come from management. These codes indicate characteristics of SMEs' situation that might hinder the dissemination of knowledge which were not addressed in the Literature Study. Furthermore, the analysis of the codes 'Difficult to find/convert into something concrete' and 'Too much material available' echoes the existing literature but also provides new and elaborated perspectives on SMEs' experiences in that regard.

5.3.5 SMEs' UNDERSTANDING OF THE UNIVERSITY AND SCIENTIFIC KNOWLEDGE

Due to the research aim of the thesis, I was interested in learning what SMEs' understanding of the university and scientific knowledge was. After all, scientific knowledge from the university is what must be disseminated to SMEs, and understanding their perspectives (and possible prejudices) in relation to this is important in order to disseminate it successfully. As was the case with the concept of 'knowledge', 'scientific knowledge' can encompass several types of knowledge products. This was discussed in Chapter 2. SMEs cannot be expected to subscribe to the same understanding of scientific knowledge as I do, which is another reason to explore their definition.

I asked all respondents the question: "How do you perceive the university and its knowledge products?" Figure 5.5 summarises the created codes.

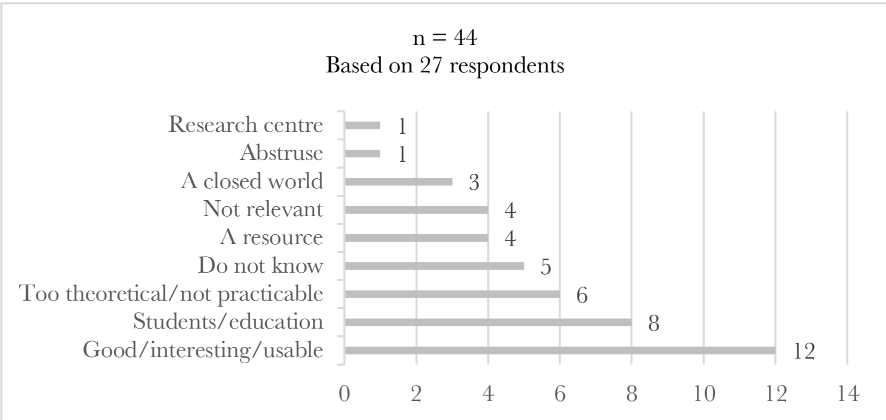

Figure 5.5. SMEs' understanding of universities and scientific knowledge

An understanding of universities and scientific knowledge as a 'Good, interesting, and usable resource' was the dominating code in this theme. Another positive articulation was that the university and scientific knowledge is 'A resource'. The following quotes exemplify these codes.

"I actually think that a lot of interesting projects are happening and I also think that there are a lot of students who keep their finger on the pulse and are really talented."	Respondent 9
"I think it (the university, *red.*) is completely indispensable. I see it as a really, really inspiring place. New knowledge is really being generated there because it is where the young, the innovative and the curious are. And I think that they sometimes are allowed to do things they would not be able to do in the business world, because the business world is concerned with costs. I think that at the university, that is my perception anyway, that when they are out there, they have room for the big ideas."	Respondent 11
"Well, from what you hear, a lot of interesting things are happening there and maybe more interesting that we will ever know."	Respondent 28
"I think that our understanding of the university is that it is awesome and that they educate some talented young people we can take in and use and choose from."	Respondent C

As these quotes show, positive articulations were often related to students. 'Students/education' was also a code mentioned relatively often under this theme. It is interesting that SMEs were prone to connect the university and scientific knowledge to students, especially related to their positive understandings. It confirms that it is not necessarily knowledge products as such that SMEs perceive as 'scientific knowledge'. Rather, it points out that talented students are important to SMEs, which could be explained by the fact that students are an inexpensive source of labour, which can be attractive to SMEs with scarcer financial resources available, and that talented students will move on to become valuable employees in enterprises which are under a constant development pressure. I will get back to this under the next theme about whether or not SMEs have used the university and/or scientific knowledge in relation to their work.

Less, but also frequently mentioned, were the more negative attitudes towards the university and scientific knowledge as 'Not relevant', 'Too theoretical and not practicable', 'A closed world' or 'Abstruse'.

"I think there are some educations where you engage too much in a theoretical level for me to see its applicability in the business world … But out of those I have worked with, a lot of them have lacked something practicable, unless they have been at the job market for a long time."	Respondent 2
"What I think is that it sometimes maybe lacks a practical touch."	Respondent 9

"I come with something self-taught and from different roads and my view on the university as an outsider is that it is a very closed world."	Respondent 11
"I think I see them, and that is of course wrong, but I see them as a separate unit and not a part of our operation or workday. I actually think that is what best characterises it."	Respondent 15
"Often, what they work with at the university (…) it is really on a different abstract level, academic level maybe than what we need. It is much more a practical level we need and then we find a solution that might not be very academic but works all right in a product we make anyway."	Respondent 25
"Well, offhand I maybe have a hard time seeing how it can be relevant here on my desk."	Respondent 26
"The world out there where you are appears so strange and closed to us."	Respondent 29

Some interesting points arise from these quotes. First, a clear distinction between practical knowledge and theoretical (technical) knowledge is drawn here. The respondents articulate that the type of technical knowledge being generated at the university is simply not useable to them because it is not practicable. This adds to the former discussion on SMEs' understandings of the term 'knowledge', where SMEs did value experience-based and practical knowledge a lot but also expressed a need for technical knowledge. Accordingly, a gap between 'their own' and 'the university's' technical knowledge exists. The theoretical knowledge of the university seems to be perceived as 'too technical' to SMEs. This is supported by Respondent 15 stating "I see them as a separate unit" and Respondent 29 differentiating between 'your world' and 'us'. In conclusion, these findings indicate that SMEs have a mental barrier regarding scientific knowledge. A similar point was found in the Literature Study: Enterprises are prone to think that scientific knowledge is too advanced for them (Alves et al., 2007; Bearden et al., 1995; Muscio & Pozzali, 2013). Second, as Respondent 9 articulates, if you have not attended university yourself, the university appears to be a very closed world. This illustrates another problem; that scientific knowledge seems unavailable to SMEs that do not have a prior relationship to the university.

Another interesting code came from a group of respondents who simply 'Do not know' how they perceive the university or scientific knowledge. To not even be able to come up with an answer says a lot. The university has a challenge to make their identity clear to SMEs. This introduces a communicative principle on promotion.

To conclude this theme, it contributes to existing research in that it illustrates that positive articulations are actually more frequent than negative ones when it comes to SMEs' understandings of universities. It demonstrates that SMEs are actually interested in scientific knowledge, in spite of the many barriers and negative presumptions (addressed both in the Literature Study and later in this study). This shows that the research aim of the thesis about improving the dissemination of scientific knowledge to SMEs is in fact justified. As a result, this analysis contributes with qualitative perspectives on SMEs' understanding of the university and scientific knowledge, which refocuses the common perspective on problems to a more solution-oriented one on possibilities. If the classical presumptions and barriers are overcome, SMEs actually see the university as an organisation of relevance to them.

5.3.6 PREVIOUS USE OF THE UNIVERSITY

Related to gaining insight into the SMEs' understanding of the university, I asked all respondents if they have ever used the university and/or scientific knowledge related to their work. The goal of this was to understand how common it was for this type of enterprise to consider the university and scientific knowledge relevant to their job-related problems. To this question, 51 percent answered 'yes' and 49 percent answered 'no'.

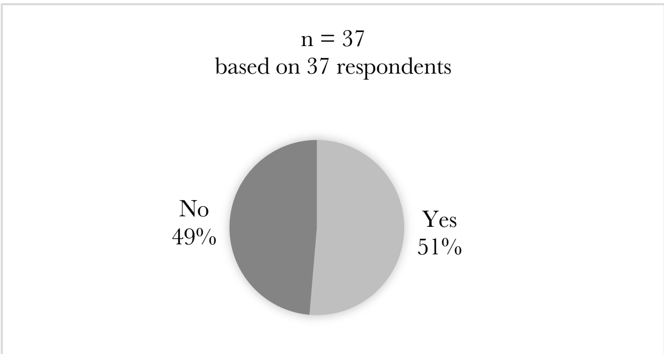

Figure 5.6. Have used university and/or scientific knowledge before

Exploring the reasons for not having used the university and/or scientific knowledge could give an idea about what obstacles a dissemination pathway must overcome, which was already examined related to the theme about barriers. The reasons given to this question also turned out to resemble the barriers mentioned previously, i.e. that it was of no particular relevance to them or that they could not imagine how they would do it. However, exploring the reasons for *having* used the university and/or scientific knowledge can provide insights into the potentials and benefits SMEs themselves identify and which can be used to communicatively play on in a future dissemination pathway. Compared to the existing literature, this also provides new perspectives on the positive outcomes of using the universities and scientific knowledge as identified by SMEs.

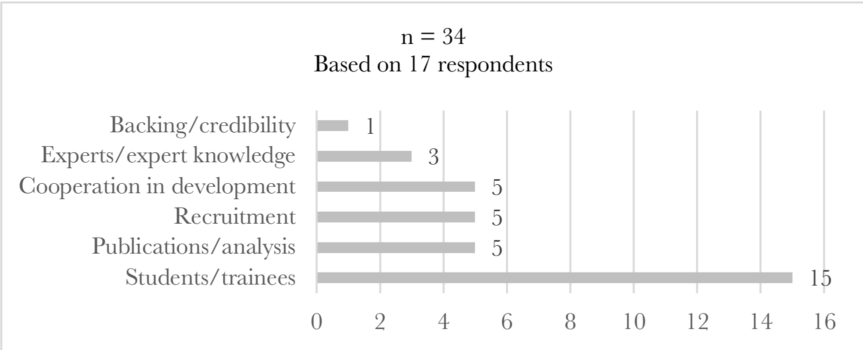

Figure 5.7. Reasons for having used the university and/or scientific knowledge

As this figure illustrates, the majority of respondents referred to 'Students/trainees' as a 'knowledge product' or 'channel' through which scientific knowledge can be accessed. It relates to what I stated earlier, that SMEs were prone to connect the university and scientific knowledge to students and, furthermore, that their positive articulations about the university and scientific knowledge in particular were often related to students. Further, it correlates with an assumption of mine (see Section 3.3.2.1.2) and because of that I was prepared to have the respondents elaborate. As a consequence, I asked all respondents what the immediate and primary knowledge product of universities was to them:

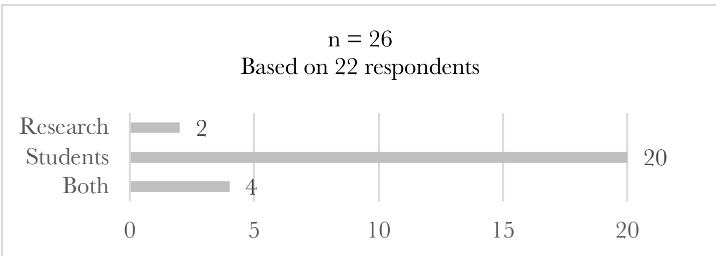

Figure 5.8. SMEs' identification of primary knowledge product from universities

This result indicates that to some extent SMEs understand that scientific knowledge *is* 'Students/trainees'. They are not necessarily aware of what other types of scientific knowledge products are available. This correlates with the pattern in Figure 5.8 being so significant that the untapped potential in the remaining knowledge products and possibilities offered by the university really stands out. These other knowledge products are, for example, scientific publications and journals, reports, statistics, information about researchers or research groups, or scientific podcasts or vodcasts. It underlines the importance of creating an awareness and clearly presenting the possibilities and the different types of knowledge products that are available and concretising how these can be used. This is another communicative principle. In this respect, it can be possible to inspire SMEs, which was an emerging code when SMEs articulated reasons to find new knowledge (Figure 5.3). In conclusion, the university must be proactive, promoting its scientific knowledge and showing its potential use and the profits thereof. This is a problem that can be solved communicatively, and it also turns out to be a primary point in the communicative principles, which I will get back to. To do this, the remaining reasons for using the university figuring in Figure 5.7 can function as arguments; it must be visualised to SMEs that scientific knowledge can be used for 'Backing/credibility', 'Experts/expert knowledge', 'Recruitment' and 'Cooperation in development'. This must be assumed to be positive possibilities for SMEs, seeing as they were mentioned here. By that, this analysis contributes with an identification of approaches and features to be used communicatively when disseminating scientific knowledge to SMEs.

5.3.7 BARRIERS TO SCIENTIFIC KNOWLEDGE

As frequently mentioned already, this theme on barriers to scientific knowledge is frequently addressed in the existing literature. However, it is relevant to include here for more reasons. First, Danish – and North Jutland – SMEs have not been explored in this context before and they might experience barriers other than those the existing literature has identified. Second, this study follows a specific research logic and research design, which might produce other perspectives than previous studies. Although the purely qualitative approach *is* used within this area of study (see Figure 4.1), examining the perspectives and understandings of SMEs by a multiple case-study and as thoroughly as this study does is quite unique.

I asked all respondents a couple of questions about their understanding of scientific knowledge and its potential use, including: 'According to you, what are the potentials and barriers to scientific knowledge?'; and 'Have you ever looked for scientific knowledge, and why/why not?'. The answers to these questions amounted to a large number of articulations about potentials and barriers to scientific knowledge. These themes have similarities with the themes on 'Barriers to new knowledge' and 'Reasons to look for new knowledge', however, they are also significantly different in that they are not so much about the respondents' general situation and preferences related to knowledge, but rather about the circumstances around scientific knowledge as a specific type of product. Figure 5.9 shows the barriers mentioned by the respondents.

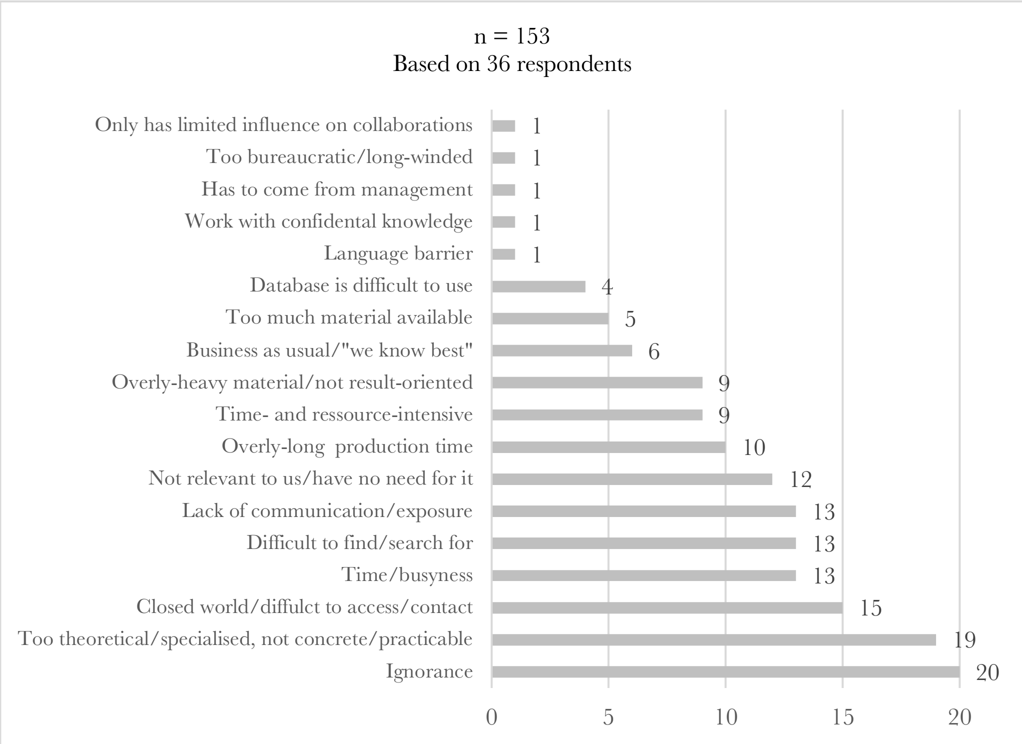

Figure 5.9. Barriers to scientific knowledge

As I will show in the following, several of the barriers from this figure are interrelated. One group of barriers can be said to relate to the 'awareness' around scientific knowledge, another to the 'form' of scientific knowledge and a third to the situation of SMEs.

5.3.7.1 Barriers related to the awareness around scientific knowledge

The barrier mentioned most frequently by the respondents was 'Ignorance'. It covered SMEs being unaware of (1) which subjects scientific knowledge engage in and (2) what scientific knowledge could possibly contribute to them and their work. Aggregated, this equals SMEs not knowing if scientific knowledge is of any relevance to them. The following quotes express SMEs' experiences in this regard:

"I would have to know what they have to offer at universities. It is too unclear. It could be really great, but it is just confusing because the university is many things."	Respondent 4
"I do not go and look on your website. But that is also because I do not know if there is anything relevant to me."	Respondent 7
"But purely technically, how we can use one another? I have difficulties connecting that because they do not know my point of view and I do not know their knowledge about it."	Respondent 18
"I do not know where to apply or what information or knowledge exists … I guess there is a webpage."	Respondent 26
"I think it can be difficult as an enterprise to figure out all the branch of studies out there and what they really cover and I have an idea that many of the students think that we the enterprises know, but we simply have no idea. If I ask people in my social circle what Interactive Digital Media cover then they are blank, we simply do not know."	Respondent C

These quotes contain articulations of "I do not know", "I guess" and "I think". They are articulations of uncertainty. The answers bear witness to the respondents simply not knowing what goes on at the universities. They do not know what knowledge exists, what the university has to offer, what branches exist, or if there even is a website. Further, they mention not going to the website, because they do not know if there is anything of relevance to them. This goes for VBN as well, which is articulated by one respondent:

Interviewer: "Could you imagine going to VBN, the research portal of AAU?" Respondent: "No, I do not think I would. It is a really good idea but I do not think I would. Mostly because I have had no introduction of it. It appears a bit foreign. It seems somewhat difficult when I do not know what it does or what it can do. If someone told me what it does and what it can do, then I am pretty sure I would."	Respondent 13

Even though this quote stands alone, it points out something central. If SMEs have had no introduction to VBN, they do not know what it can do for them. This underlines the importance of the university <u>promoting</u> scientific knowledge and the channels to SMEs, which is one of the communicative principles. Related to this is the barrier that scientific knowledge is 'Difficult to find/search for', which relates to another communicative principle, that of <u>providing</u>.

"We cannot search for it. We do not know where to look. We do not know who to follow. We do not know when it is relevant."	Respondent 13
"I just think it would be too heavy to find and what should you search for and how do I look around in it and so on."	Respondent C

These quotes illustrate that SMEs have many doubts regarding the search for scientific knowledge. They do not know where to look, what to search for, how to look around in it or when it is relevant. Further, they expect it to be "too heavy to find", which is an unfortunate combination. At the same time, while SMEs largely did not know what scientific knowledge exists or where/how to find it, they simultaneously had an immediate understanding of scientific knowledge being 'Not relevant to us and we have no need for it'. This is problematic. SMEs were not only unaware of what scientific knowledge existed, furthermore, their immediate understanding was that it is not relevant to them.

"I have not had a need for it, and I have a legislation I have to follow, and I guess research is a stage before legislation, so I have not had the need to talk to any researchers yet."	Respondent 6
"I do not need it."	Respondent 17
"I have not found anything out there recently that has been of interest to my area, and therefore, it is just not the road I take."	Respondent 22
"Well, offhand I maybe have a hard time seeing how it can be relevant here on my desk."	Respondent 26
"What is really important to us is knowledge about market and strategy and knowledge about creativity. I do not know. I do not think that the university has a role to play there."	Respondent A

As the quotes show, SMEs often immediately deem scientific knowledge non-relevant because of an *immediate assessment* of it not being relevant. This relates to the 'Ignorance' mentioned earlier. It is another unfortunate combination. Accordingly, eliminating the ignorance could improve SMEs' assessment on relevance. It relates to what I stated under the previous theme; that it is necessary to clearly present the possibilities and the different types of knowledge products that are available and to demonstrate how these can be used. I can now add that it is not only the types of knowledge products that must be concretised (which is one of the communicative principles), but also the subjects which scientific knowledge deals with. SMEs must be able to know that scientific knowledge engages in creativity, socio-economics, marketing and so on. On a related note, the analysis showed that SMEs tended to think of scientific knowledge's relevance in relation to their *primary product* and not related to all these other examples and subjects. If SMEs only ever think of scientific knowledge related to the actual development of the enterprise, a lot of possibilities remain uncovered. Collectively, concretising and exemplifying scientific knowledge could allow for SMEs to be inspired and possibly increase their use of scientific knowledge. In this relation, a quote by Respondent 25 is interesting:

"It could be because I feel like I do not need it. But if I suddenly need it then I might consider it. It is like when you walk around in the mall not needing anything and then you find out that you do need something anyway because you drop by something."	Respondent 25

The comparison to the situation in the mall suggests that if scientific knowledge is concretised, SMEs' ignorance could be eliminated and a desire to 'shop for scientific knowledge' could emerge. This could be desirable, and it adds a new dimension to the existing understandings of SMEs' use of scientific knowledge. With these conclusions, several other barriers mentioned in Figure 5.9 appear to be related, i.e. 'Business as usual/we know best". When the respondents mention that scientific knowledge is not relevant to them, there is an undertone of them thinking that the university cannot teach them anything. This is of course an interpretation, but the following quotes support this interpretation:

"Well, I do not think I could find anyone who knows more about Facebook or advertising. Maybe more on the creative part. Regardless, I have not met anyone who knows as much as we do, because we sit with it every day."	Respondent 9
"To be a bit opinionated, we actually believe that the services we deliver are ahead of existing research and what they find of interesting solutions. Because we are handling these issues, it is hands-on."	Respondent F

Once again, this relates to the 'not invented here-syndrome' (Baltes, 2000; Bearden et al., 1995; Decter et al., 2007; Sher et al., 2011), which was addressed in the Literature Study. The 'not-invented-here-syndrome' also influences the point mentioned above about SMEs tending to think of scientific knowledge related to their primary product, and not, for example, related to how to run and optimise a business or develop staff. While SMEs can believe that they are the best at what they do, this does not necessarily apply to all areas of the business. It might particularly apply to their core development processes. But if SMEs learned that they *can* actually gain from scientific knowledge, both related to their core development and related to, for example, the improvement of business processes, they would learn that they do not always know best themselves and that scientific knowledge could be of value on subjects other than what they immediately think of. This would improve their assessment of relevance.

Actually, all of these barriers now analysed are closely related to the barrier about a 'Lack of communication/exposure', which is also frequently articulated by respondents and it is of great relevance to the research aim of this thesis. It is interesting that it actually turned out to be so frequently mentioned by the respondents. It proves that communication is a central part of this problem area, not only to me and the thesis, but to the SMEs as well. Accordingly, the communicative principle about promotion is central.

"I am sure you are testing a lot of things that we do not always notice. I am sure a lot of interesting things are happening that could benefit us, but how do we access that knowledge that you might conduct research about and spent a lot of energy on? It is about communicating it to us who could potentially find it interesting."	Respondent 5
"Well, I might have an idea that a lot of genius things are being made at the different universities, but that they are also sometimes just made and then go nowhere, if they do not really lift it out or somehow channel it to practice."	Respondent 11
"But what news comes from there is not something I hear about. I do not know where to hear about it (…) I do not meet it. I do not think that the public in general, if I can talk generally, I do not think they meet it either. Where would you?"	Respondent 14
"I actually do not know if they work on that. But they surely do not communicate it."	Respondent 15
"I am thinking about how I would access it or how it is available to me. Because, well, it has not really been. I do not think it is something that has found me. It has not."	Respondent 21
"I think I would need some information from you about what you specifically have to offer."	Respondent 27
"I wish there was a more standardised way for the university to present their research results and the programs they might be working on."	Respondent F

These quotes strongly indicate that there is a severe lack of communication from the university about its scientific knowledge. Without communication, SMEs will not experience a need for scientific knowledge. It is up to the university to clearly communicate the possibilities specifically to SMEs. Only then will the ignorance be diminished. Only then will SMEs begin to see relevance in scientific knowledge; only then will a desire to 'shop for scientific knowledge' be made possible. More specifically, the university must accept that SMEs will not proactively look for scientific knowledge, and that they need the university to proactively communicate it to them. This is the essence of the communication principle on promotion. The following quotes illustrate this:

"Well, you can say that the people conducting research on something also communicate it or offer a dissemination that I would find really interesting. Because otherwise you would have to be actively investigative and it is difficult to actively investigate something if you do not know what it is."	Respondent 14
"It is difficult for us to be proactive towards the university and draw knowledge out that way. It is easier if they come to us and tell us what they are doing right now, then it would be low-hanging fruit to us."	Respondent 23
"We do not have time to look for them, I would say. But I hope they will call us. We are on board, that is our approach. If things make sense or seem fun and worth a shot, then we are in."	Respondent E
"Maybe I should be a bit more proactive and stay updated on it, but we also have a business to run. So, if enterprises are truly to understand the universities, then it has to be made accessible and easy."	Respondent G

Understanding the situation of SMEs, i.e. that they are under a constant time, resource and development pressure, means accepting that they will not proactively look for scientific knowledge, especially when they do not know what it is they are looking for. By that, all these barriers are interrelated. The university must strive to be the proactive partner in this constellation and demonstrate to SMEs what scientific knowledge is, and is about, and how it can be of value to SMEs. This analysis has shown that despite barriers, SMEs actually want to engage with the university and scientific knowledge – but they need the university to initiate it.

On a related note, the SMEs mentioned that the university comes across as a 'closed world' that is 'difficult to access/contact' to them. This is also a communicational issue.

"It should not be too closed a world to the business world. That might be their primary, that they have to make themselves visible to the business world."	Respondent 5
"I come with something self-taught and from different roads and my view on the university as an outsider is that it is a very closed world."	Respondent 11

"I come from the university myself and it is my old mathematics teacher we happen to be in contact with, so there are some relations that entail us to relatively quickly and informally build some things up."	Respondent 20
"We do not have any experience with it and we do not have a culture or what to call it, we are not used to it. The world out there where you are, it appears to be so strange and closed to us."	Respondent 29

These quotes show that regardless of SMEs' background (if the employees have attended university or are self-taught, or whether or not the SME has a tendency to use the university) they need the university to be open to them. You should not have to have an "old mathematics teacher" you are still in contact with in order to be able to access scientific knowledge. All SMEs need to feel 'invited' to scientific knowledge. As several quotes in this entire study illustrate, a distinction between "them" and "us" is frequently articulated. It bears witness to SMEs experiencing being very separated from the university. This experience could profitably be eliminated, which can (at least partly) be done by communicating differently and more openly inviting SMEs in. In conclusion, SMEs need scientific knowledge to be promoted and provided (communicative principles).

5.3.7.2 Barriers related to the characteristics of scientific knowledge

A barrier mentioned almost as frequently as 'Ignorance' is that scientific knowledge is 'Too theoretical/specialised, not concrete/practicable'. This is a barrier related to the characteristics of the scientific knowledge.

"The problem is that the issues we have are not theoretically on this level."	Respondent 1
"And again, you can say that a lot of it at universities are theoretical where what we miss is sometimes the more practical. If we have to advice some client we cannot simply glance at theory, we have to make sure that it works in practice."	Respondent 12
"It is really difficult, because what many of them are doing is so specific. How in the world can that specificity be laid out as general in order for me to find it and search for it?"	Respondent 14
"Often, what they work on at universities or at the university here is actually at a different, abstract level, a more academic level than what we need. It is much more a practical level we really need, and you may find a solution that is not be very academic but functions okay anyway in a product you develop."	Respondent 25

"We are not a Novo Nordic that donates five years to conduct research within a specific subject. Our use of the university must be much more application-oriented, and it must be something that meets a specific need."	Respondent F

This is a central problem related to a fundamental characteristic of scientific knowledge. Scientific knowledge is often very specific and theoretical and does not necessarily have a practical orientation. This is very difficult to change and it would require efforts of a character other than what the insights provided by this thesis allows for. However, understanding this barrier creates an awareness about what SMEs need from scientific knowledge, and it points to the communicative principle on reorganising. In order for SMEs to be able to implement it to their own situation and issues, they need scientific knowledge to be practically oriented rather than theoretical; and general rather than too specific. They need it to be application-oriented and usable to solve specific needs. In total, it must be reorganised. How this can be done within the limits of this thesis will be explored in the Development phase.

Another considerable challenge the respondents mentioned was 'overly long production time': As also addressed in the Literature Study, SMEs generally work on a short-term basis, while universities do not. This often means that scientific knowledge remains beyond reach, since SMEs simply cannot wait for the knowledge to be produced and published. Also related to the characteristics of scientific knowledge is that it is 'Overly heavy material/not result-oriented'. Universities must consider ways of transforming their knowledge into products that will meet the SMEs' list of criteria, which relates to both the communicative principle on reorganising and the one on concretising.

"I am not going to sit down and read a thesis that is 100 or 300 pages long, it has to be quick information because things are moving fast and there is no time to read a large thesis about one subject. It has to be boiled down to something I can use."	Respondent 4
"When I see that there are 200 pages and maybe something specific I need to use, well, there is not always a surplus of mental resources … it is typically when I have a specific problem that I need knowledge, and to then have to start something where I do not really know if it will provide me with an answer. And the material is simply too heavy and typically in English in order for me to use it."	Respondent 8
"You would definitely catch my attention 100 percent better visually than if you write a report with 100 pages. Sure, I will read that report if you have caught my attention, but you have to catch it first."	Respondent 10

"Make it short. Because research projects and student projects are often long, quite long."	Respondent 13
"I have heard speakers from university researchers within music and they give talks in a way that is so lecture-like, as they have been accustomed to in the last 20 years in an auditorium. That might not work in the environment you go out in. So, there is something about how you communicate it that really has to be thought about."	Respondent 14
"I just want to say one thing that can be difficult, because one time we received a letter from the university, you can hear about this, it is actually quite interesting. We received a letter from the university, we read it and we did not understand it. So, we tried to see what the readability index was, and it was around 27-28, it was completely hopeless. I think a newspaper is around 10-12 or something like that. And this letter was 28. That language, it caused the information to be put aside, which was a shame. It could have been interesting but you just could not understand what it said, even though it is well-educated people we have … So, if you want to share knowledge and you want to reach different professions and enterprises then you have to make sure it is readable and understandable."	Respondent B
"If I have to read a master thesis then maybe half of it is stuff I cannot use for anything and then you have read 300 pages and there might be one of them you can use for something (…) It has to be more specific, boiled down much more. If you could write a mini report, a one-page report about each master thesis, that would be perfect."	Respondent D

These quotes give valuable insight into SMEs' understanding of scientific knowledge and what it would require to make it more usable and relevant to them. They will not engage in long reports or theses where the outcome is unclear. The outcome and how to use it must be immediately identifiable or else they will move on. Further, from these quotes some criteria for how scientific knowledge should be presented according to SMEs can be listed: It has to be short and specific; containing information that can quickly be decoded; and where the relevance is immediately identifiable. It should be communicated according to the target group and not as a lecture or scientific paper and its content should be practically useable, result-oriented, visually 'catching', and in an understandable language. That language can pose a barrier is illustrated nicely by Respondent B and this was also identified in the Literature Study: The often eclectic and speculative language of universities, versus the more focused and practical language of enterprises can lead to misunderstandings and a lack of interest to interact (Alves et al., 2007; Gattringer et al., 2014; Ranga et al., 2008; Siontorou & Batzias, 2010). This barrier is difficult to overcome because it has to do with the knowledge production processes of individual researchers. However, ways for transforming the form of scientific knowledge so it meets the criteria of SMEs should be explored in order to ensure a successful dissemination, hence the reorganisation principle. Accordingly, the Development phase of this thesis will experiment with how existing scientific knowledge can be formed and presented differently and in agreement with SMEs' criteria.

Related is the barrier of scientific knowledge being 'Time- and resource-intensive'. By this, respondents refer to the time and resources they have to spend in order to use scientific knowledge. Because of the barriers related to the characteristics of the knowledge, SMEs experienced it as rather demanding to use:

"I think that related to the university specifically it can also be because it sometimes has to be planned in advance. If we have to use the university then it sometimes demands that expectations goes both ways and then we also have to spend time and resources on it."	Respondent 11
"Published papers are not free and then you have to either use some students who can access it for free or you have to pay for it, and that is all right. But if you have to buy some papers and if you are busy and "oh I have to come up with something new" then you lack the incentive to pay 200 € for a number of papers that you just find online and print out. Then you need a clearing to be allowed to use this money on research."	Respondent 18
"I think that sometimes the barrier is that we have to spend too much time and too much money on applying a new small thing that might only result in a small improvement. And then it can sometimes be difficult to see the improvement in the long run."	Respondent 23

As these quotes show, this barrier is not as much about SMEs being pressed for time (although that barrier also emerges again in this theme) as it is about SMEs experiencing that scientific knowledge demands too much time and resources of them. Accordingly, the problem to be solved is to make scientific knowledge easier for SMEs to use (reorganise and concretise), which the aforementioned criteria can help to do. However, another pressing problem brought up by these quotes is the problem regarding open science (or a lack thereof). It is a hot topic that is frequently debated these days, and it does in fact pose a substantial problem to the research aim of this thesis that a lot of scientific knowledge cannot be accessed free of charge by SMEs. However, it falls outside the scope of this thesis to solve this problem. I will, however, bring the debate on open science up again in the final part of the thesis, discussing the societal context in which the results of this thesis must be seen, and addressing some further studies that could be conducted.

That scientific knowledge has an ‘Overly long production time’ is another barrier articulated by SMEs.

“There is not really any theory, a few books have been published, but again, typically, when a book is published then they might have spent six months writing it and it is already outdated when it comes out.”	Respondent 12
“It takes a long time for new research to gain acceptance and become a permanent part of the working day.”	Respondent 18
“Well the biggest challenge is probably that it takes a long time compared to us, we have some things, well, we are an enterprise working with very, very short horizons and sometimes large decisions have to be made from one day to the next and at the same time we actually want to support some industrial PhDs with a three-year horizon. It is definitely a challenge.”	Respondent 20
“The only appeal is that you cannot control a scientific production, and of course we do not want to, not at all. But it is mostly the time perspective, it just does not always go very fast.”	Respondent F
“We are not as close to development that has a five-year horizon, it is too far away from us business-like. We need something where we are closer to being able to capitalise on it.”	Respondent G

These quotes qualitatively confirm what was also addressed in the Literature Study, in which enterprises also identified that universities taking too long publishing and commercialising their scientific knowledge is a barrier that can cause scientific knowledge to automatically be opted out (Hansotia, 2003; Lakpetch & Lorsuwannarat, 2012; Vaidya & Charkha, 2008; Yusuf, 2008).

5.3.7.3 Barriers related to the situation of SMEs

This type of barriers has already been analysed in-depth in relation to a previous theme. The barrier on ‘Time/busyness’, for example, emerges again here and involves the same perspectives as already addressed under the previous theme on ‘Barriers to knowledge’. Accordingly, I will not repeat them here. There are, however, a few barriers related to the situation of SMEs that were brought up again in the context of the present theme which pointed out new perspectives. These are that knowledge ‘Has to come from management’ and that some SMEs ‘Work with confidential knowledge’. Both these barriers can be labelled as distinctive features because they were only mentioned a couple of times each. However, although they are particularities, they do bring to light some important perspectives on the situation of SMEs. That ‘It has to come from management’ indicates that some employees in SMEs are not searching for knowledge themselves, that it is not part of their job description.

It could thus be interpreted that they are accustomed to doing 'as they are told'. While it might sound a bit harsh, it reopens the debate about who or what constitutes an SME. When has scientific knowledge successfully been disseminated to an SME? Is it when the individual employee accesses it and is able to use it, or is it when a group of employees do? Certainly, reaching one employee does not automatically mean that the SME as a whole gains access to it, which was also addressed under the theme 'Barriers to knowledge' where the code 'Difficult to share internally' emerged. To make it most likely to reach the 'whole' SME, knowledge and scientific knowledge need to be 'shareable'.

Collectively, the analysis of this theme has turned out to mainly support findings from the existing literature. It has, however, added qualitative documentation of SMEs' experiences as well as explored the situation across a range of SMEs, which is quite a unique methodological approach in this context. Furthermore, the insights into SMEs' understandings of scientific knowledge and what it would require to make it more accessible, relevant and usable to them adds to findings from existing literature. The point about SMEs tending to think of scientific knowledge in relation to their core development is a new and important understanding. This study also sets itself apart from existing studies by taking a solution-oriented focus on the barriers and how they can be solved communicatively.

5.3.8 POTENTIALS TO SCIENTIFIC KNOWLEDGE

A theme on potentials to scientific knowledge emerged from the same questions as the previous theme on 'Barriers to scientific knowledge'. These questions were: 'According to you, what are the potentials and barriers to scientific knowledge?'; and 'Have you ever looked for scientific knowledge, and why/why not?'. When answering these questions, a lot of perspectives on the potential to gain scientific knowledge were articulated as well. As mentioned earlier, this theme is somewhat similar to the theme on 'Reasons to look for new knowledge', however, it is significantly different because it relates to the circumstances around scientific knowledge as a specific type of product.

Compared to the existing literature, the analysis of this theme adds a qualitative perspective on SMEs' positive identifications related to scientific knowledge, which, once again, refocuses the common perspective on problems to a more positive one on possibilities. However, as mentioned earlier, because the Literature Study of this thesis mainly analysed barriers and problems to the dissemination of scientific knowledge between knowledge institution and enterprise, I do not have a systematic foundation for saying that this analysis provides new insights. However, of the literature I have read (unsystematically) during the course of my PhD, I have not come across studies with this focus.

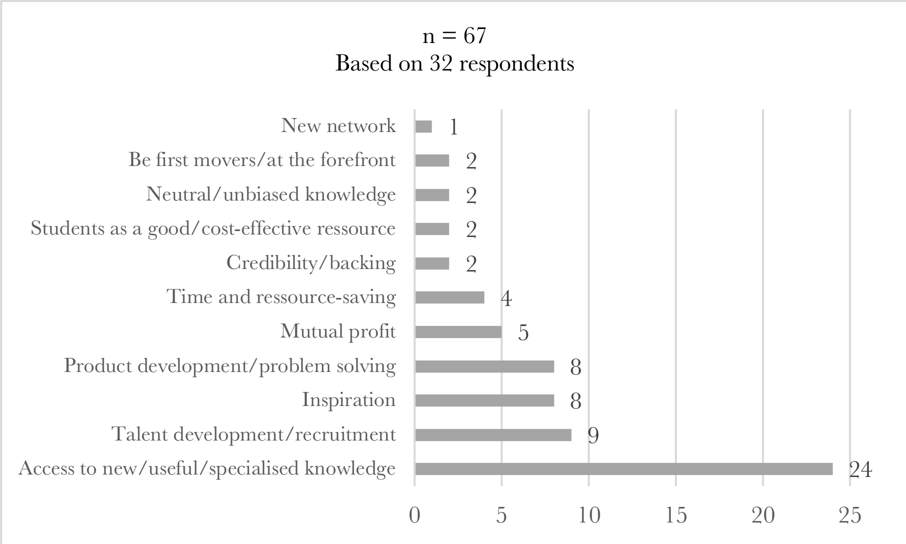

Figure 5.10. Potentials to scientific knowledge

The codes under this theme are articulations of the positive outcomes of using scientific knowledge as they are identified by SMEs. While some of these codes are very similar to codes that have been analysed in relation to earlier themes, i.e. 'Inspiration', 'Students as a good/cost-effective resource' and 'Be first movers/at the forefront', others are new. However, the codes under this theme illustrate what SMEs find lucrative about scientific knowledge. Accordingly, they can be used communicatively as arguments to convince SMEs that scientific knowledge is a valuable knowledge source to them. The code identified most frequently under this theme is 'Access new/useful/specialised' knowledge.

"A pro is that it is innovative. And that is always, we go on experience, I have said that more times that it is the experience, but we also have to remember innovation and you (the university, *red.*) can definitively contribute with that because you have more resources for innovation than we do."	Respondent 5
"A few weeks ago, a colleague sent me an analysis made by a professor (…) And it was very useful and I read it, around 30-40 pages of analysis that were very useful."	Respondent 19
"Well, I believe that they (the university, *red.*) are always 100 percent updated. I have the idea that they are. That is my immediate assessment, without having anything to back it up. I would think that you have the required theoretical knowledge."	Respondent 27

"The universities also have a good approach to the constructional. They contribute a great deal in terms of research and design."	Respondent B
"And because we believe that the people sitting in the universities are best at it."	Respondent E
"Well, in our field it is completely evident that the division for energy planning at AAU is strong so we have collaborated with them more times and we actually want to do more to collaborate with them."	Respondent F

This bears witness to SMEs actually identifying a great value and potential in scientific knowledge, even though it might stand in the shadow of all the barriers and negative presumptions they have identified. However, as Figure 5.10 shows, accessing new/useful/specialised knowledge is particularly relevant and important to SMEs. It can be a means to live up to the constant development pressure and the constantly-changing surroundings. Accordingly, communicating this potential while also diminishing some of the barriers SMEs identify could prove efficient.

Also mentioned frequently was 'Talent development/recruitment'. Similar to the code on 'Students as a good/cost-efficient resource', which echoes the previously-identified code on 'Students/trainees', the code on 'Talent development/recruitment' indicates that SMEs understand new employees as 'channels' or relational pathways to access relevant scientific knowledge. Recruiting talented, newly-qualified people is very valuable to SMEs who need to be first movers and face a constant development pressure in an ever-changing market.

"It is very much about talent development within the field where we need them. And there you just have to say that some branches of study have begun to pop up where they are really, really good. For example, those we get from Interactive Digital Medias and the like, shut up they are competent. It is extreme. And there the university really helps us by increasing the entire standard but also by getting some knowledge in that we can really use."	Respondent 1
"Maybe the theory they learn in school is outdated tomorrow but it does not really matter as long as they have an interest and are inspired for it, then they are surely ready to keep updated in the long run. So, it is those candidates we of course must have and live off."	Respondent 12

'Product development/problem solving' also figures relatively high on the list in Figure 5.10. This also relates back to the identified need for constant development and an orientation towards solving pressing problems. Interestingly, SMEs do articulate that scientific knowledge could potentially be of value to these very central needs, which is important knowledge related to the research aim of the thesis. The question, then, is how to make it easier for SMEs to actually acquire and use scientific knowledge for these purposes. The communication principles and the Development phase will explore how this can be done.

Some of the less-frequently-mentioned codes in this theme are also interesting, i.e. to 'Be first movers/at the forefront', that scientific knowledge is 'Neutral/unbiased knowledge' and that it can be used as 'Backing/credibility'. These codes give some ideas about what SMEs can also use scientific knowledge for:

"There are many who are neutral in a connection, the university somewhere they bring the neutral you can say, without it being a sales pitch."	Respondent 6
"But if there is something to say for it, this is, as I see it, a neutral attitude towards a specific issue or subject, where there is no commercial interest. I see that as incredibly positive."	Respondent 8
"The customers do not give a shit about quality and price. They are after completely different things, and we have been out telling the customers that this is knowledge, that we have it from these two professors and that it is about price not even being that interesting."	Respondent 30
"To refer to that division for energy planning again, they have spent a lot of resources on researching the future of power plant heat: smart, intelligent energy systems. Some of the results they have found are, for us, a perfect match to the business model we have and actually some of what we already do. This gives us some authority when we are marketing our services, that there is scientific backing."	Respondent F

Worth noticing is that all the codes identified in this theme make up attributes that can help SMEs optimise their conduct of business. As analysed here, scientific knowledge can *in fact* be valuable to SMEs, and, accordingly, the codes from Figure 5.10 can be used to <u>concretise</u> scientific knowledge, and communicatively as arguments to convince SMEs that scientific knowledge is valuable and worthwhile to them.

5.3.9 CHANNELS TO CONTACT THE UNIVERSITY

A final theme I found profitable to explore related to the research question of the thesis is how SMEs (would) contact the university. Specifying this can give some indications as to where and how SMEs look for scientific knowledge at present and how these entry points could potentially be improved, according to SMEs.

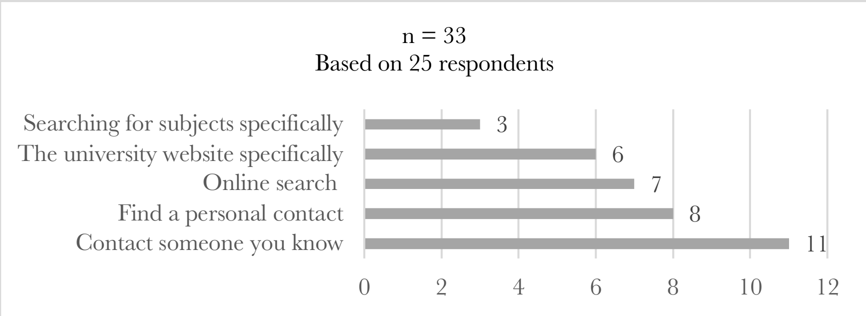

Figure 5.11. Channels to contact the university

To several of the respondents, answering this question was a 'forced' answer: They often stated that they would *not* contact the university. They then answered according to what they imagined they would do. Therefore, these answers are mostly based on conceptions rather than actual experiences. This does not, however, rule the results out. Exploring how SMEs *would* contact the university is valuable in order to understand what contact options a future dissemination pathway should provide. As Figure 5.11 shows, SMEs said they would be most prone to using a relational pathway to get in contact with the university. A lot of respondents mentioned that they would call someone. It could be someone they know already, or they would call a secretary and have them put them through to a relevant person. Further, SMEs expressed being especially likely to 'Contact someone you know'.

"I took a course with him once. He works out there and I have his phone number. I have talked to him about, there was a case with some damp in a floor sometime. And I guess it is because I can point back to that specifically that it is our contact for it."	Respondent 6
"I come from the university myself and it is my old mathematics teacher we happen to be in contact with, so there are some relations that entail us to relatively quickly and informal build some things up."	Respondent 20
"I guess I fundamentally would not search for it. But then I would, well I know several here who have a close contact to the university and still have more contacts within computer science for example, so I guess I would contact one of them and then try to get a contact that way. Otherwise you could write directly to someone out there because you would be able to recognise some of the names, I think, if you made an online search."	Respondent 21

This is a valuable understanding because it could possibly mean that SMEs without prior personal contacts at the university are less prone to make contact and thus also to access scientific knowledge. Further, as the quote by Respondent 21 exemplifies above, out of the respondents who articulated 'Online search' and 'The university website specifically', more of them mentioned these as a way to find a personal contact:

"I think I would just start Googling it, if it was something on social media I think I would Google social media and AAU because that is the one I immediately know and then I would see where I ended up. Then my experience is that you often get to a page where there are pictures of some persons and then I guess I would send them an email."	Respondent 9
"But I guess the university is so far ahead in Aalborg that if I went to their website and looked I am pretty sure I rather quickly would be able to find information about how to get in contact if I want to collaborate."	Respondent 29

A couple of respondents, however, mentioned that they would not search for contacts but for subjects:

"Subjects. I would look for subject. I definitely would."	Respondent 17

This result appears peculiar, seeing as only a few respondents mention it, but it is nevertheless interesting. The point about searching specifically for subjects has been brought up earlier in this study in relation to creating awareness about what subjects existing scientific knowledge addresses. Now, categorising contact options according to subjects could also be an interesting preference. Enabling SMEs to find an interesting subject and at the same time find a contact opportunity would fit some of the criteria articulated by SMEs. In conclusion, making a search on subjects and personal contacts available could be options that would make scientific knowledge easier for SMEs to access, which is a new perspective provided by this study.

5.4 SUMMARISING THE FINDINGS

Several of the insights in the analysis above echo what the Literature Study also showed. By that, this study strengthens the common knowledge on the field. However, as pointed out during the analysis, this empirical study has also contributed with several new and nuanced insights about the perspectives of SMEs and their preferences regarding external knowledge acquisition. Summarising the study's findings and contribution will provide an answer for the second sub-question: What characterises the situation of SMEs and their relation to (scientific) knowledge? Accordingly, the study can be used to understand what must be taken into account when developing a new dissemination pathway, and for that reason the summary will continuously reflect on this.

The analysis demonstrated that SMEs experienced knowledge being very important to them. They expressed that knowledge is "fuel to their business" and that they constantly needed to update their knowledge to keep their business going and justify their existence. SMEs distinguished between two types of knowledge: (1) experience-based knowledge (know-how), which related to how to perform a task or a job-related problem; and (2) technical knowledge (know-that), which was a more theoretical knowledge i.e. about the market, the consumers, theories, regulations, prices and technologies. The experience-based knowledge appeared to be the primary knowledge for SMEs. In fact, the analysis indicated that to SMEs, experience *is* knowledge. Further, SMEs were explicitly aware of this, which means that scientific knowledge could potentially be deemed valuable by them. The contribution of this analysis consisted of new perspectives on how SMEs defined and experienced using knowledge; that they used experience-based and technical knowledge respectively for different purposes, and that they explicitly found knowledge essential to run their business.

Analysing the theme on 'Channels to find new knowledge' showed that the SMEs used several different channels to find new knowledge. Frequently mentioned was 'Colleagues', which indicated that SMEs preferred to access knowledge through a relational pathway. This supported the conclusion that SMEs preferred experience-based knowledge. It also witnessed that knowledge had to be quickly identifiable and practicable, cost-effective and needed to entail a solution to a pressing problem. Asking a colleague can be said to nurture a habitual way of thinking and working, and as a consequence, a 'we know best ourselves' mentality can occur, which can make it difficult to disseminate external knowledge to SMEs. Accordingly, the university must show SMEs that scientific knowledge exists and can actually be of relevance. Another frequently-mentioned channel was 'Online searching', which is also a way to find experience-based knowledge (inspiration, what others have done before) and technical knowledge (i.e. rules and regulations), that is both quick and cost-effective. Further, 'Online searching' implied that SMEs were oriented towards searching outside of the enterprise for new knowledge. Seeing as 'Online Searching' is a generic pathway, it appears that a personal relationship was not entirely necessary to SMEs' search for new knowledge. Other channels identified indicated that SMEs were oriented towards subject-specific knowledge and ad-hoc knowledge that provided ideas and inspiration specific to market and business. The analysis showed that while using generic pathways was not foreign to SMEs, using generic pathways to find scientific knowledge in particular was only rarely mentioned. Incorporating features of a relational pathway into a generic pathway could be a way to disseminate scientific knowledge according to the preferences of SMEs. From analysing this theme, it can be concluded that according to SMEs, knowledge must be easily and quickly accessible, personalised, experience-based and specific (according to the business or market area), cost-effective (due to a lack of resources), providing both experience-based and technical knowledge, and experimenting with incorporating relational pathways (or features thereof) into generic pathways. Because scientific knowledge is a specific type of knowledge, these characteristics can be said to apply to scientific knowledge as well. This listing of characteristics was one of the contributions provided by this analysis. Another contribution was that the analysis outlined the diverse channels SMEs used to find new knowledge.

The theme on 'Reasons to look for new knowledge' showed that SMEs looked for new knowledge primarily for one of two reasons: (1) when they had to solve a pressing problem or task, thus looking for precise information or (2) when their task was to update their knowledge and find inspiration by looking for new ideas, technologies, processes and products. In continuation hereof, a contribution of the analysis was that it identified two types of searches: the 'purposeful search' and the 'inspirational search'. Further, the analysis of this theme specified that SMEs were not only under constant time and resource pressure, which is commonly addressed in existing literature, but also under constant development pressure. This contextual insight constitutes one of the contributions of this analysis. SMEs are in constant need of developing their ideas, products and solutions, which related to another conclusion: That SMEs experienced accessing new knowledge as very important. They needed to be first movers. Scientific knowledge can provide ideas, insights and methods that can help them achieve this. Accordingly, scientific knowledge could in fact be of relevance and value to SMEs if disseminated properly. Here, the analysis showed that presenting scientific knowledge in a way that allowed for 'being inspired' could be profitable. In total, this analysis contributed with a solution-oriented perspective on the possibilities (as identified by SMEs), which can be used to improve the dissemination process.

Analysing 'Barriers to new knowledge' provided several insights of value to the research aim of this thesis. Some barriers could not be solved by insights provided by this thesis, i.e. that SMEs are busy, have limited resources and work in a disturbing and noisy environment. However, these circumstances did illustrate that scientific knowledge must be presented and disseminated in a way where it is quickly identifiable how to use it in order to solve specific work-related problems. A number of barriers that *could* potentially be solved by insights provided by this thesis were also identified. First, the idea that knowledge is difficult to find and difficult to convert into something concrete was frequently mentioned. It witnessed the characteristics of scientific knowledge being too difficult for enterprises to translate into practice. Accordingly, it must be easier for SMEs to search for knowledge and to convert it into solving job-related problems. A related barrier was that too much material is available. Online knowledge is not necessarily organised in a way that makes sense to individual SMEs. For this thesis, this understanding shows the need to develop a generic pathway where scientific knowledge is organised in a way that makes sense to SMEs and where they will experience that searching for it is easier and more effective. This encompasses being better at showing SMEs how to find the knowledge and how to use it, thus concretising it. The profits of using it must be immediately recognisable, otherwise SMEs will deselect it. Doing this could also illustrate to SMEs that they do not always know best themselves, thus making them more open to external knowledge acquisition. The quotes from the analysis showed that SMEs themselves are explicitly aware that the 'knowing best ourselves' attitude could pose a challenge to them. Accordingly, SMEs need the university to help them diminish this attitude. Further, this analysis showed that SMEs need knowledge to be 'shareable' and, accordingly, a new dissemination pathway should incorporate solutions on how to share knowledge with colleagues. While this analysis confirmed several findings from existing literature, it also documented and elaborated on perspectives on SMEs' experiences in that relation.

Analysing the barriers specifically related to scientific knowledge specified that SMEs were largely ignorant about what goes on at the university. To SMEs, the university was a closed world, especially to the SMEs without a prior relationship with the university. The analysis demonstrated a need for SMEs to feel 'invited' to use scientific knowledge, and that this cannot only be for the SMEs who have a connection at the university. Further, the analysis showed that SMEs had difficulties determining what subjects the university works on and how and where to find scientific knowledge. A very unfortunate combination of SMEs being ignorant as to what scientific knowledge is and simultaneously deeming it non-relevant was identified, which could prevent SMEs from using scientific knowledge related to their work. As a consequence, it must be ensured that SMEs know what subjects scientific knowledge engages in so that they know what it is they need to know and how and where to search for it. The analysis continuously showed that there was a severe lack of communication and promotion from the university about its scientific knowledge. Understanding the situation of SMEs, i.e. that they are under a constant time, resource and development pressure, means accepting that SMEs will not proactively look for scientific knowledge, especially when they do not know what it is they are looking for. Accordingly, the university must be the proactive partner who (1) shows SMEs what subjects scientific knowledge addresses, (2) shows SMEs where to find scientific knowledge and (3) demonstrates how it can be of value to SMEs by showing them how it can be converted into practice and used to solve their work-related problems. This requires scientific knowledge to be practically-oriented rather than theoretical, and general rather than too specific. SMEs needed scientific knowledge to be application-oriented and usable in order to solve specific needs. Furthermore, the outcome of using scientific knowledge must be immediately visible. Some criteria for how scientific knowledge should be presented according to SMEs could be listed: It has to be short and specific, containing information that can quickly be decoded and where the relevance is immediately identifiable. It should be communicated with an understanding of the target group in mind and not as a lecture or scientific paper. Its content should be practically usable, results-oriented, visually 'catching', and presented by subjects and in an understandable language. One respondent compared the search for scientific knowledge with going shopping in the mall: While you might not think you need anything, you can be convinced that you do if you see it right in front of you. This idea suggested that through communication and inspiration, SMEs' ignorance about scientific knowledge could be diminished and replaced with a desire to 'shop for scientific knowledge'. This is a specific idea for a future dissemination pathway. Further, the point that scientific knowledge has to be internally 'shareable' to SMEs emerged again in this analysis. Accordingly, a new dissemination pathway should somehow take into account that individual employees should be able to use it and that they are enabled to share it with their colleagues. The contribution of this study has been a confirmation and documentation of several insights from existing literature and an in-depth and solution-oriented perspective on SMEs' experiences related to the barriers around scientific knowledge. Further, identifying that SMEs tended to think of the relevance of scientific knowledge in relation to their core product and development (and therefore often deem scientific knowledge irrelevant, because they believe that they themselves are the experts on this) showed an untapped potential in communicating and inspiring SMEs to see the possible use of scientific knowledge on other business-related areas. Doing this, however, will require resources seeing as the scientific knowledge must be transformed and communicated differently.

The study also provided insights into SMEs' understanding of the university and scientific knowledge. Here, positive understandings of universities and scientific knowledge as a good, interesting and usable resource dominated. Less, but also frequently mentioned, were the more negative attitudes of the university and scientific knowledge as not relevant, too theoretical and not practicable, a closed world and abstruse. To disseminate scientific knowledge successfully to SMEs then means to make clear how it can be used in practice and how technical knowledge can become practicable. The fact that a positive articulation was most frequent indicated that aspiring to improve the dissemination of scientific knowledge to SMEs is justified. However, this analysis showed that the classical presumptions must still be overcome in order to achieve the research aim of the thesis. This analysis indicated that to SMEs, the knowledge being generated at the university is not useable because it is not practicable. The university develops theoretical knowledge perceived as 'too technical' by SMEs. These findings indicated that SMEs have a mental barrier regarding scientific knowledge. A number of respondents also articulated that they simply did not know how to even perceive the university. As a result, the university has a challenge to make their identity clear to SMEs. In order to disseminate scientific knowledge to this target group, this is essential. The analysis also demonstrated that if the classical presumptions and barriers are overcome, SMEs actually see the university as an organisation of relevance to them. The importance of scientific knowledge not only being for those SMEs that have prior relations to the university was also stressed again. When developing a new dissemination pathway, this should be kept in mind. The contribution of this analysis was an awareness of SMEs' positive understandings actually dominating the negative ones. The analysis showed that if the classical presumptions and barriers are overcome, SMEs actually see the university and scientific knowledge as relevant to them.

The analysis showed that 51 percent of the respondents had used the university related to their work on previous occasions. The majority of these referred to students or trainees when asked how they had done it. Students as a 'knowledge product' or 'channel' to access scientific knowledge has been a reoccurring theme throughout the analysis: The positive articulations about the university and scientific knowledge are often specifically related to students. While it points out that talented students are important to SMEs, it also stresses that there is an untapped potential in disseminating the remaining knowledge products and possibilities offered by the university to SMEs. It would be beneficial to give SMEs an awareness of this. Accordingly, the different types of knowledge products should be presented and it should be clearly demonstrated how they can be used. The contribution of this analysis is that is showed SMEs' one-sided understanding of scientific knowledge as primarily coming from students. That the analysis stressed the necessity of making SMEs aware of the different products of scientific knowledge that are available and demonstrate their use is an important contribution that adds to existing literature.

Analysing the theme of 'Opportunities to gain scientific knowledge' also provided some ideas about the positive outcomes of using scientific knowledge as identified by SMEs. Accordingly, the codes under this theme can be used communicatively as arguments to convince SMEs that scientific knowledge can be a valuable knowledge source to them. Here, SMEs mentioned using the university to access new, useful and specialised work-related knowledge; to develop talent and to recruit qualified people; to be first movers; to develop their products and solve problems; neutral knowledge; and for backing and credibility. These are attributes that, according to this analysis, are of great relevance and importance to SMEs and their overall situation. The contribution of this analysis was a documentation of SMEs' perspectives and positive identifications related to scientific knowledge, which can be used communicatively as arguments to convince SMEs of the potentials of using scientific knowledge.

The last theme of this analysis was 'Channels to contact the university'. It was analysed that SMEs are most prone to using a relational pathway to get in contact with the university, and that they were especially likely to contact someone they already knew. Accordingly, it could be relevant to ensure that a personal contact is made easy-accessible to all SMEs, including those with no prior relations to the university. Searching online was also a popular channel for SMEs, although it was often used to search for a personal contact. In conclusion, the focus of this analysis in itself contributed to existing findings. Further, showing that using generic pathways to find relational pathways or that feature relational pathways could be a valuable option is also a new contribution of this study.

Generally speaking, to accommodate SMEs' situation and provide scientific knowledge according to their preferences will require the university to be willing to put time, efforts and resources into changing both the form of the scientific knowledge and the way it is communicated. The Development phase of this thesis will explore and exemplify how this can be done.

5.4.1 SUMMARISING SPECIFIC IDEAS FOR A DISSEMINATION PATHWAY

As the analysis bears witness to, several specific ideas for ways to disseminate scientific knowledge to SMEs emerged during the interviews. These ideas come from the respondents themselves and could be of value to the Development phase of the thesis. Although it was not a goal of this analysis, I will list these ideas in order to possibly include them in the further work of the thesis. Note that this list of ideas is created unsystematically from my read-throughs of the transcribed interviews. Further, I have reformulated the ideas from the original quotes and they have thus undergone an interpretation.

Relational pathways

- The university offering seminars about practical business-related issues (Respondent 2)
- Scientists proactively contributing to branch-specific arrangements and medias (Respondent 14)
- Providing information about scientific knowledge where professionals gather (and in their language) (Respondent 14)
- Inviting SMEs to participate in student projects (Respondent 20)
- PhD Candidates visiting enterprises to give inspiration for knowledge and collaborations (Respondent 23)
- The university offering a two-hour seminar once a month about the newest research on branch-specific subjects (Respondent A)
- Segmented after-work meetings where the university proactively offers to facilitate some processes (Respondent A)
- The university offering branch-specific summits (Respondent A)

Organisational changes

- Thinking dissemination as part of the research in the beginning rather than in the end of the research process (Respondent 14)
- Hiring communicators to disseminate the scientific knowledge (Respondent 14)
- Formalising collaborations and appointments between universities and SMEs, i.e. via speaking events, thus supporting that it will be easier for SMEs and researchers to find each other (Respondent 17)
- Explaining the individual branches of study and what they can do in an enterprise (Respondent C)
- Orientating the branch organisations so they can help communicate new scientific knowledge (Respondent F)

Generic pathways

- A commercial site or a knowledge bank containing quick, practical and usable information (Respondent 4)
- A website with a support function (Respondent 6)
- A website cataloguing scientific knowledge in subjects, offering a news-like summary of current knowledge (Respondent 8)
- A search function, classified according to subjects (Respondent 13)
- A how-to manual: A short and precise presentation of reports and papers (Respondent 13)
- A system that somehow provides a substitute for the personal relationship (Respondent 14)
- Implementing scientific knowledge into branch-specific newsletters or medias (Respondent 15)
- Direct and personal e-mails with relevant content (Respondent 19)
- A forum, easy to find, promoted by the university (Respondent 22)
- A database that allows SMEs to search on subjects (Respondent 25)
- Segmented news mails (Respondent A)
- A Facebook-page or the like where light-versions or infographic overviews of published research are made available, pushed directly to employees (Respondent C)
- A knowledge bank organised in subjects where all information about a subject is collected, where knowledge can be shared with students and professors, and which is marketed specifically at SMEs (Respondent D)
- Accessing all information about the current and future research projects systematically and in one place, thus enabling inspiration for possible use and providing an opportunity to offer yourself as a possible stakeholder/collaborator, cutting out the need for a personal relationship (Respondent G)
- An easy, accessible and dynamical database with information about knowledge groups, institutes, master theses, professors and research subjects (Respondent G)

Figure 5.12. Ideas for future dissemination of scientific knowledge identified in Study B

As this figure bears witness to, the majority of ideas involve a generic pathway. Further, the figure shows that some ideas from the thematic analysis reappear, for example that scientific knowledge should be easy to access, i.e. made available through a website, presented in subjects, providing an overview of the possibilities, and proactively targeted at SMEs by universities. It echoes some of the general findings of the study and will be used as understandings and ideas going into the next phases of the thesis.

5.5 COMMUNICATIVE PRINCIPLES FOR THE DISSEMINATION OF SCIENTIFIC KNOWLEDGE TO SMEs

As mentioned in the beginning of this chapter, this study aimed to understand the situation of SMEs in relation to (scientific) knowledge in order to learn how to disseminate scientific knowledge to them according to their own perspectives and preferences. In line with the dissemination of scientific knowledge being regarded as a communication process (see Chapter 2), the results of this study can be converted into some communicative principles for the dissemination of scientific knowledge to SMEs. By that, an answer for the third subquestion (SQ3) can be provided: What are the communicative principles for the dissemination of scientific knowledge to SMEs?

As the analysis and the summary have illustrated, exploring SMEs' experiences and self-understanding has resulted in the discovery of several characteristics on how to disseminate scientific knowledge to SMEs. Using such understandings to outline communicative principles has – to my knowledge – not been done before. Communicating scientific knowledge according to these principles means to attempt to do it according to the perspectives, preferences and overall situation of SMEs. It means to provide an organisation of knowledge that makes sense to SMEs and where they will experience that searching for it and using it is easier and more effective. It is a way to engage the receiver in the communication and thus make it an interactive and dialogical process (see Chapter 2 for a discussion on this). By that, these principles are a new contribution of this study and of this thesis. Summarised from the analysis in this chapter, the communicative principles for disseminating scientific knowledge to SMEs are:

1) Promoting
2) Reorganising
3) Concretising
4) Providing.

First, scientific knowledge must be promoted. It must be made visible to SMEs and their attention must be drawn to it. To do this, the university must proactively promote (push/market) scientific knowledge specifically to SMEs. The analysis has shown that SMEs will not come looking for it. Promoting scientific knowledge to SMEs means making them aware of its existence. To push/market/promote scientific knowledge has proven to be central to SMEs, by which the thesis' focus on communication is shared by the target group. Second, scientific knowledge must be reorganised. This requires that the form of the scientific knowledge is changed. Scientific knowledge must be made application-oriented, result-oriented and practicable. It must be general rather than too specific. It must be practically-oriented rather than too theoretical. It must be short and make an outcome immediately visible. It should be visually 'catching' and possibly presented by subjects. And it should be written/spoken/presented in an understandable language. Third, scientific knowledge must be concretised. The university must show SMEs what subjects the scientific knowledge addresses and what types of knowledge products exist. Further, how these subjects can be used to solve specific and practical work-related problems must also be illustrated. Concretising scientific knowledge means offering examples of how it can be translated into practical use and profitability, showing SMEs that scientific knowledge can help them solve pressing work-related problems (experience-based knowledge) and how technical knowledge can make it possible for them to identify scientific knowledge as a relevant knowledge source. By that, the university must show SMEs that scientific knowledge can be used for both developing their core products (which SMEs tend to think they are best at themselves) and for other business-related subjects, such as staff development, project management or marketing. This ties together several points of this study: Concretising scientific knowledge to SMEs could inspire them to see the diversity of subjects and potential relevance and thus learn that they do not always know best themselves. Fourth, scientific knowledge must be provided to SMEs. It must be provided where SMEs already look for new knowledge, i.e. websites, market-specific communities, business networks and physical arrangements. The study has also indicated that generic pathways with relational pathway features could be especially usable to SMEs. This could help in promoting scientific knowledge but it could also make scientific knowledge more accessible and easier to find. Connecting scientific knowledge to other knowledge sources that SMEs find relevant can also make scientific knowledge appear more relevant to them.

Collectively, these communication principles can diminish SMEs' ignorance related to scientific knowledge and show them that it can actually be of relevance to them and that it can be easily accessed, understood and put to use. The communication principles are an expression of what the analysis has proven to be important according to SMEs. As already mentioned during the analysis in this chapter, not everything is possible within the frame of this thesis. For example: Reorganising scientific knowledge requires multiple and grand transformations of traditions and procedures within the scientific world, which is not part of this thesis. However, Study A and Study B have pointed out that it is required in order to successfully disseminate scientific knowledge to SMEs. Therefore, what *will* be part of this thesis is to explore and experiment with the organisation of scientific knowledge within a current Research Information Management System (a generic pathway), exemplified by AUB. For this reason, the next study, Study C, will explore the content of such a system in order to illustrate its possibilities and restrictions. After that, the Development phase will transform the communication principles into an actual dissemination pathway. This will entail inviting SMEs to participate in a development process in order to develop an idea and a design that meets the criteria of SMEs and puts the communication principles into practice.

5.6 FINAL REMARKS: METHODOLOGICAL ISSUES

This empirical exploration of SMEs' situation has specified the factors that influence SMEs' association with knowledge and scientific knowledge. I have strived to examine the created themes and codes inductively from the transcripts of the interviews, which have provided valuable insights into the experiences and self-understanding of SMEs. The goal of the study has been to understand SMEs as a group and explore the heterogeneities and homogeneities *across* cases. However, because I have not analysed heterogeneities and homogeneities *within* the individual SMEs, I do possess a lot of data that I have created in connection to the study but not used systematically and explicitly. Although I have approached the SMEs as individual cases, I have not conducted in-depth case studies, which was also not the intention, as discussed in Section 3.3.2.1. The go-alongs helped me obtain an initial impression of SMEs' situation, thus setting the course for the interviews, which were conducted afterwards; they have not been put to systematic use in this analysis. They provided me with a sense of the physical surroundings and how this affected their work, collaboration and relations. By that, they were used to let the situation determine parts of the semi-structured interviews. Had I attempted to conduct an in-depth single-case study, the go-along data and the other types of data created could have been put to more systematic use. This would have resulted in a more in-depth understanding of the individual SMEs because it would have allowed for an analysis of heterogeneities and homogeneities within that SME. By that, it would have been possible to say something about the knowledge intensity and absorptive capacity of that particular SME. That, however, would not provide the insights required for the further stages of the thesis and for answering the research question. Because the definition of SMEs is so relatively broad (see Table 1.1), I found it valuable to explore different types of SMEs in order to get a picture of SMEs more broadly. Accordingly, I believe that the goal of the study has been accomplished, even though a lot of data remains to be further explored.

As stated in Section 3.3.2.1.1, the SMEs for this study were selected from a maximum variation principle and, further, I aimed at selecting 'representative' or 'typical' cases. As stated in Section 3.3.2.1, a goal of this study was to learn what is typical and atypical for SMEs. Accordingly, a reflection on whether these SMEs can actually be considered typical would be in order. While I am left with a feeling that some cases might be more extreme, I actually am not able to conclude anything about the individual SMEs from this analysis. Deeming the individual cases typical or extreme would have required me to conduct an in-depth study of them individually, which, as just argued, was not what I did. However, as the figures of this analysis illustrate, a lot of codes were mentioned by several respondents by which patterns have actually emerged, and I can conclude that many of the analysed circumstances recur across trades, size and subject. The larger SMEs characterised as high-tech knowledge-intensive services in the study (see Table 3.1) do however appear somewhat extreme in comparison to the remaining cases of the study. This is not surprising. Not only do they have more resources available, they also work with advanced trade and technology development. In their interviews, the respondents mention the university and scientific knowledge more often and more spontaneously than the others. By that, scientific knowledge is to a greater extent part of their product development, which results in this type of enterprise having a more explicit orientation towards the university and scientific knowledge. The SMEs engaged in knowledge-intensive market services appear to see a potential value in scientific knowledge although they often mention not using it as much as they could or would. Further, they often have previous connections to the university, especially through student collaborations. The SME categorised under knowledge-intensive financial services appears to be the SMEs to which the university and scientific knowledge is most distant. This can, however, only be characterised as a hunch based on this type of analysis. In total, each type of SME can be said to have extreme and typical features in their relationship to knowledge and scientific knowledge. In reality, it seems to depend on the individual employee. There is a group of employees that are typical to SMEs across trades and subjects, i.e. human resources, economics, management, to which scientific knowledge is always potentially valuable. Other types of workers in knowledge intensive enterprises, i.e. receptionists or customer advisors, may generally find it more distant. For these reasons, I find it valuable to have involved multiple types of SMEs and multiple types of employees in the study. Seeing as SMEs are in fact so diverse, understanding them as a group is difficult. This study has been an attempt to do so.

Naturally, more SMEs could have been chosen, as could more respondents with different backgrounds, which would have added extra dimensions and validity to the study. This could be an idea for further studies, where understanding the individual types of SMEs identified in this thesis could also be interesting to explore.

A final reflection will regard the assumptions that I wrote down prior to the data-creation and analysis of this study (see Section 3.3.2.1.2). As it turned out, most of my assumptions turned out to be verified, i.e. that SMEs did not experience a need for scientific knowledge, partly because they did not know what this knowledge is or where to find it. Other assumptions were confirmed but toned down a bit. For example, I assumed I would find that SMEs did not in any way include the university or its scientific knowledge into their work procedures. The study turned out to verify this, but with the important difference that SMEs expressed that the university and scientific knowledge could potentially be of relevance to them and their work procedures. The fact that my assumptions have mainly been verified is something to reflect on. It bears witness to my assumptions being valid. Of course, they come from somewhere: Many assumptions prevail in this area of study, and I have met many people, i.e. at conferences within the topic, who express them; I have also found them mentioned in several publications. In conclusion, these assumptions are not uncommon. A positive outcome of this study is that these assumptions have now been documented and no longer need to be assumptions. This study has systematically explored the perspectives and experiences of SMEs related to scientific knowledge and has turned the assumptions into valid results.

CHAPTER 6: EXAMINING A RESEARCH INFORMATION MANAGEMENT SYSTEM

In this chapter I will examine and exemplify what a Research Information Management System is (Study C). The goal is to provide an answer for the fourth sub-question (SQ4): How is existing scientific knowledge presented and organised in a Research Information Management System (a generic pathway), and how does it correlate with the preferences of SMEs? First, a definition for this type of system will be established and second, a single case study will be conducted in order to exemplify and analyse such a system. The case for this study will be VBN (Knowledge Base of Northern Jutland), which is the Research Information Management System of Aalborg University. As mentioned in Section 3.3.3, VBN is considered a 'typical' case (Yin, 2009) because it builds on the same system (the Pure research intelligence system) used by all Danish Universities (Elsevier, n.d.-b). As also mentioned in Section 3.3.3, the goal of this study is to explore the database and its contents, thus making clear what data (existing scientific knowledge) is available, how it is organised and presented, and how it can be subtracted and in which form. In other words, the goal of this study is to explore the characteristics of the existing scientific knowledge that is located *in* VBN as opposed to conducting an actual database analysis *of* VBN. This will provide an understanding of possibilities and limitations within this type of system that will be the foundation for the Development phase of the thesis, where a generic pathway will be developed in order to explore and concretise how existing scientific knowledge (Pure data) can be presented and disseminated to SMEs.

6.1 DEFINING 'RESEARCH INFORMATION MANAGEMENT SYSTEM'

As already mentioned, universities generally face an increased need to manage and disseminate their scientific knowledge. Societal focus on 'the knowledge economy' (Powell & Snellman, 2004) and 'the information society' (Raban et al., 2011) has resulted in a growing awareness of universities and their knowledge production. Scientific knowledge is regarded as an essential enabler in this knowledge economy and, accordingly, appropriate management is vital to universities (Nyirenda, 2017). Because of this, Research Information Management Systems are commonly used by universities to manage and disseminate scientific knowledge. Research Information Management Systems – also named 'Current Research Information Systems', 'profile systems' or 'networking tools' (Givens, 2016) – are institutional repositories used to gather scientific knowledge across a variety of academic departments in one place, thus enabling other researchers and business and society to access it.

> "… a university-based institutional repository is a set of services that a university offers to the members of its community for the management and dissemination of digital materials created by the institution and its community members. It is most essentially an organizational commitment to the stewardship of these digital materials, including long-term preservation where appropriate, as well as organization and access or distribution." (Lynch, 2003, p. 328)

Accordingly, a Research Information Management System is an online archive, a research portal, and a centralised and integrated database that aims at synchronising data across a university and securing online availability. It can be used by both researchers and administrative units to manage and organise digital material, thus reducing their burden of collecting and managing data. This not only provides better internal reporting at universities, it also provides greater visibility of institutional research activities, by which it becomes a strategic tool for reputation management (Dempsey, 2014). However, even more benefits (can) arise from proper use of Research Information Management Systems: They can be used for publication management and support open access; they can be used for research analytics and reporting; they can help showcase scientific knowledge to a global audience; they can enhance the visibility of a university and its researchers, within the university and to the outside world; they can enhance credibility and transparency of scientific knowledge and of the university; they can assist researchers in creating and managing research profiles; and they can be a tool for identifying expertise for grant applications or interdisciplinary research collaborations.

However, the practical use of Research Information Management Systems is not without its difficulties, which previous studies have addressed (see for example Nyirenda, 2017 for an overview). Furthermore, the increased use and professionalisation of Research Information Management Systems is not only a result of universities *wanting* to systematise the organisation of their scientific knowledge. Universities are also increasingly *obliged* to document their scientific endeavours, which is a consequence of the political agenda addressed in Chapter 1. Because governments and politicians view management of scientific knowledge as a paramount task for universities and other higher educational organisations (Nyirenda, 2017), Research Information Management Systems are a tool for tracking research output and analysing scientific impact.

6.1.1 THE PURE SYSTEM

Several products have emerged to support Research Information Management Systems in recent years (Dempsey, 2014), one of which is the Pure Research Intelligence Systems by Elsevier. Elsevier offers a range of research management solutions. Other than the Pure Research Information Management System, Elsevier also provide analytical services, strategy tools, funding solutions, a citation database, supporting tools and more (Elsevier, n.d.-d). As mentioned in Chapter 1, the Pure Research Information Management System is made to reduce the administrative burden for researchers, faculty and staff and it has a threefold purpose (Elsevier, n.d.-e). First, it is meant to *enable* research, which means to secure funding, identify and recruit researchers and establish partnerships. Second, it is meant to help *conduct* research, which means to discover, read, review, analyse, synthesise it and so on. Third, it is meant to help *share* research, which means to manage, publish and disseminate data and to commercialise and promote it. Pure features include:

- Capturing and reusing data from multiple channels
- Validating and certifying research data
- Profiling researchers
- Identifying subject area experts and relevant research funding
- Reporting
- Analysing and tracking research progress
- Monitoring the research grant lifecycle and success rates
- Showcasing accomplishments and facilitating collaboration (Elsevier, n.d.-c)

When using Pure, universities can build reports, carry out performance assessments, manage researcher profiles, enable research networking and more. All of this constitutes *explicit* and *demonstrative* scientific knowledge products (see Chapter 2 for a discussion on these typologies). As previously mentioned, all Danish universities use Pure implementations for their research information management; Aalborg University is no exception. In the following, I will describe and analyse VBN and the data it contains in order to exemplify what a Research Information Management System can and cannot do, as related to the research aim of this thesis.

6.2 EXEMPLIFYING A RESEARCH INFORMATION MANAGEMENT SYSTEM: THE CASE OF VBN

VBN is the institutional repository and research database of Aalborg University and it builds on the Research Information Management System by Pure (Elsevier, n.d.-a). It is managed by the VBN Editorial Office which is part of

Aalborg University Library and has handled the university's research registration since 1992 (VBN Editorial Office, n.d.-b). The purpose of VBN is to render research activities visible and to make published research available to the public (VBN Editorial Office, n.d.-a). VBN serves as an online, full-text archive in which the following types of metadata are registered:

- Researchers
- Research
- Research projects
- Activities
- Press clippings
- Research units

In the following I will describe and analyse the organisation and presentation of knowledge in VBN. On a methodological note, because this exploration is done by me, my perspective and understandings will influence the descriptions somewhat. However, even though I have a specific reason to conduct this study, I do strive to provide an objective description and analysis of VBN and its content. Due to the research aim of the thesis, I am, however, particularly focused on visualising and describing the overall presentation and organisation of content, for which reason I focus especially on the structure of the interface, the navigational system, controlled and uncontrolled indexing terms and metadata. By this, the goal is to substantiate an analysis of VBN's quality and consistency. This will provide insights into the character of existing scientific knowledge, which will be transformed and disseminated via a new generic pathway according to the preferences of SMEs (Chapter 5) in the Development phase of the thesis. Because the following analysis is limited to descriptions of what can be seen from navigating through VBN, explanations of various elements or intersubjective understandings of use hereof will not be part of this study. This would have required different types of data, i.e. interviews with the VBN Editorial Office or qualitative studies of users' browsing and interaction with the digital content.

6.2.1 ANALYSING VBN

VBN can be characterised as a web interface (Preece et al., 2015). It is a responsive website where layout, graphic design, font and appearance changes according to the screen size it is being displayed on. VBN has both a Danish and an English version. For this analysis, the English version of VBN is displayed on a computer screen. Screenshots for this analysis were taken on October 17th 2017.

6.2.1.1 The home page

First, looking at the layout of the home page, it consists of seven sections:

Figure 6.1. The VBN home page

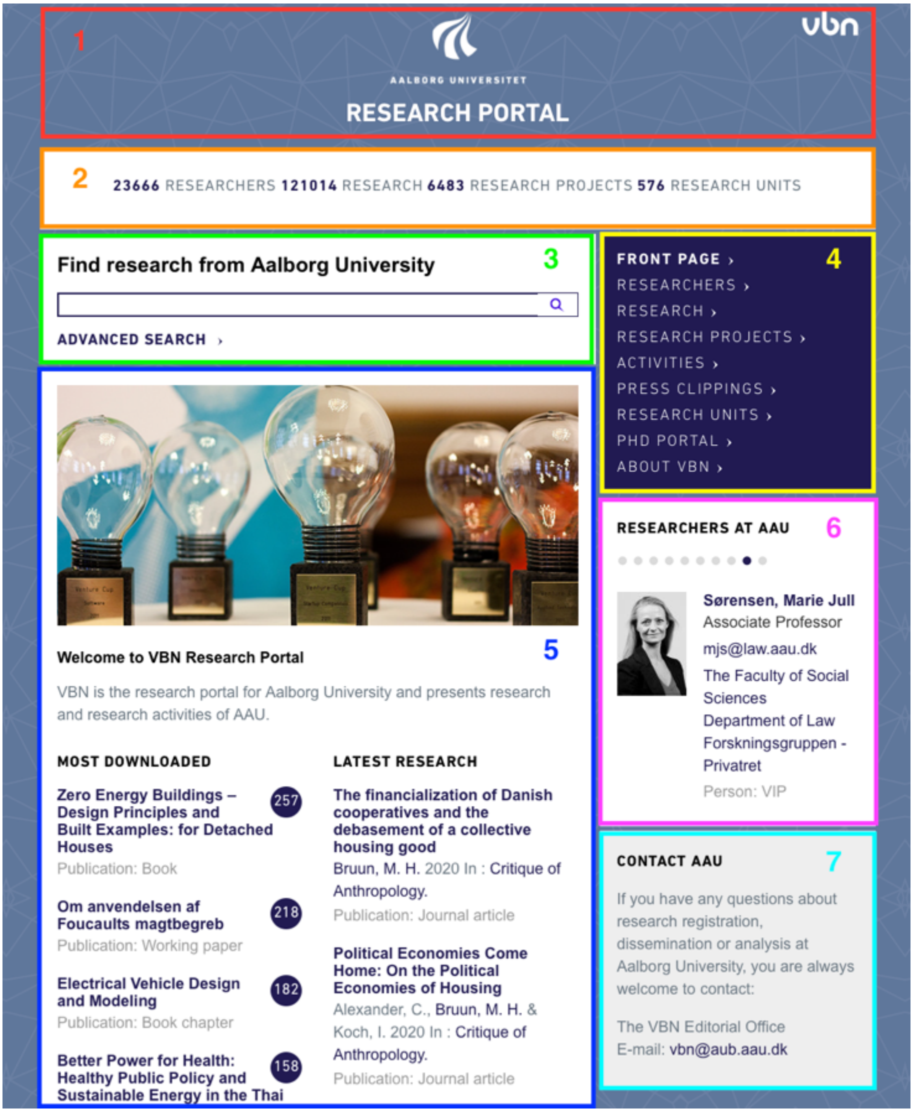

Figure 6.2. The seven sections of the VBN home page

Section 1 contains the AAU logo, with a hyperlink to the AAU website, the text 'Research portal', with a hyperlink to the VBN home page, and the VBN logo, which also provides a hyperlink to the VBN home page. Section 1 reappears at all subpages of the interface, and so does section 3 and section 4.

Section 2 is a banner that provides alternative organisation and entry points to the main navigational indexing terms. These are 'Researchers', 'Research',

'Research project' and 'Research units'. My interpretation of this prominent placement of such a banner is that it presents the content (the scientific knowledge) rendered most important by VBN to make available to the users. In this banner, an animation of numbers counting up is used to illustrate the large amount of content available under each of these indexing terms. What effect this has on users is not possible for me to say. One possibility is that users find it intriguing; how high will the number go? Another possibility is that users find it overwhelming; is there really that much data available, where will I even begin?

Section 3 is a search box, prominently displayed on all pages of the interface.

Section 4 is the interface menu which offers a list of headers (indexing terms) for the user to scroll through and select from. The content of the menu is invisible; it only drops down when a header is selected and clicked on, by which the user is also directed to the page in question. Accordingly, while on the home page, the menu is limited to a flat menu illustrating six main indexing terms of the interface: 'Researchers', 'Research', 'Research projects', 'Activities', 'Press clippings' and 'Research units'. Further, indexing terms of 'PhD portal' and 'About VBN' figures. Clicking on either of these will direct you away from VBN and to different interfaces. Only when actually clicking on one of the six main indexing terms does the interface menu expand and show more options. According to Preece et al. (2015), the various options under a menu are typically ordered from top to bottom in terms of most frequently-used options. Without being able to say for sure, it seems likely to also be the case in this organisation and menu. Another option is, however, that they are ordered according to the amount of data. The fact that most data is available on 'Researchers' and 'Research' supports this interpretation.

Section 5, which is placed in the centre of the interface, contains a picture of light bulbs/awards, a short text which presents the interface and two rows of different content (indexing terms): One with 'Most downloaded' and one with 'Latest Research'. Both of these are teasers or so-called content promos (Krug, 2000), where the newest and most popular content is highlighted. Section 5 reappears on all subpages with varying content; this is the section where the various search results appear. Judging on the placement (centre stage) and the size of this section, it can be said to be the most important part of the website (Tidwell, 2011). However, it does not really come across as 'more important' than the remaining sections. For example, the colours do not vary and the headlines are not bigger than in the remaining sections. The only thing that attracts extra attention to this section is the picture and the central placement of the section. However, because all the sections are quite similar in their appearance, one could argue that all content is equally important.

Section 6 provides a short-cut to researcher profiles, which can otherwise be accessed by choosing 'Researchers' in the interface menu and then scrolling through the alphabetical list of researchers on the subpage. Section 6 is a 'changing' element, where different researcher profiles automatically replace each other. This selection and representation appears to be based on coincidence. Further, section 6 is designed like a business card, providing a picture (if available), a name, a title and information about affiliations. However, because the information for these business cards is automatically generated from the individual researcher's profiles, they sometimes appear quite insufficient, which is illustrated in Figure 6.3.

Figure 6.3. Insufficient researcher profile

Here, a fundamental challenge regarding Pure data in VBN is exemplified: The content is primarily generated by the individual researchers, and if they do not feed the interface with information, information will simply not be there. It has to do with the research registration process itself. While bibliographical content data is mostly registered in mandatory fields consisting of controlled indexing terms, other fields are voluntary and consist of uncontrolled indexing terms, i.e. subject-related content such as publication title and abstract, number of pages and keywords. Furthermore, many of these fields are not mandatory, i.e. publication abstract and number of pages. Because of this, the quality of content is very inconsistent. I will get back to this problem.

Section 7 contains contact information for the VBN Editorial Office, thus offering users a way to get help if needed.

Collectively, the home page offers different entries to the content (scientific knowledge). Further, as illustrated in Figure 6.1 and Figure 6.2 the home page is characterised by being largely text-based. Apart from the AAU logo in section 1, there is only the static picture of light bulbs/awards in section 5 and the small, changing pictures of researchers in section 6. There are no icons, which are otherwise often used as representations of objects instead of text-labels in order to make it easier for users to learn and remember features of the interface (Preece et al., 2015). Further, there are no graphics, sounds, videos or animations (apart from the number-based one in section 2). Accordingly, the VBN home page can be said to be somewhat demanding to use; it requires of the users that they are willing and capable to engage in a lot of text. The main concern of the interface is to structure text-based information, and provide text-based hyperlinks to other pages or links. The interface gives a serious impression, which might be a consequence of the scientific nature of the content data.

When you navigate from the home page and on to the subpages, you access the different types of scientific knowledge available, organised according to category headers, which are controlled indexing terms.

6.2.1.2 Content category: Researchers

When you choose 'Researchers' from the interface menu, you are navigated to a subpage where different ways to categorise this type of content are presented.

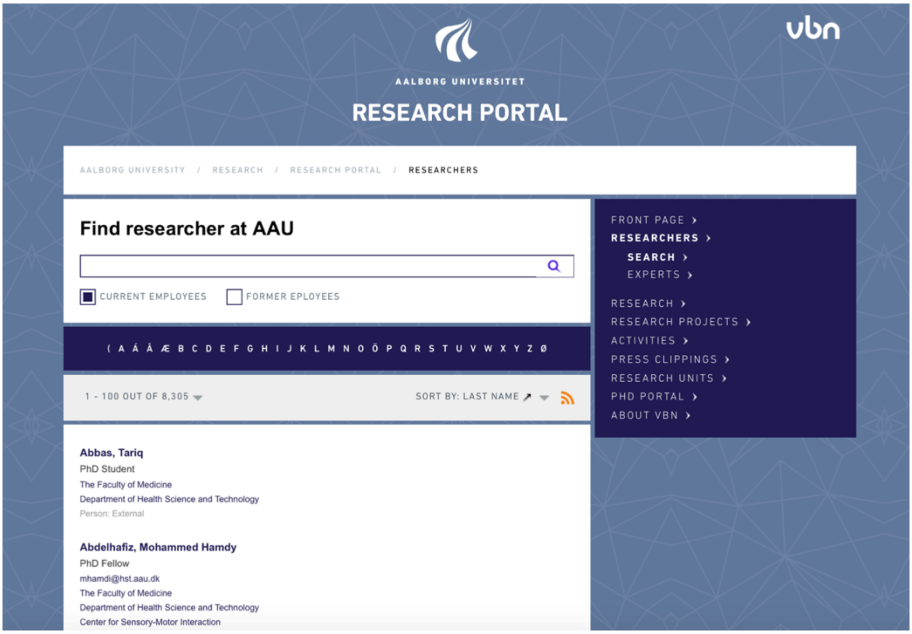

Figure 6.4. Organisation of content about 'Researchers'

You can search for researchers using the search box, you can categorise according to current or former employees, you can search by letters, or you can choose from a list containing 8.305 controlled search results, sorted by last name. Another option is to click on ‘Experts’ in the expanded interface menu (section 4), by which a number of new options occur.

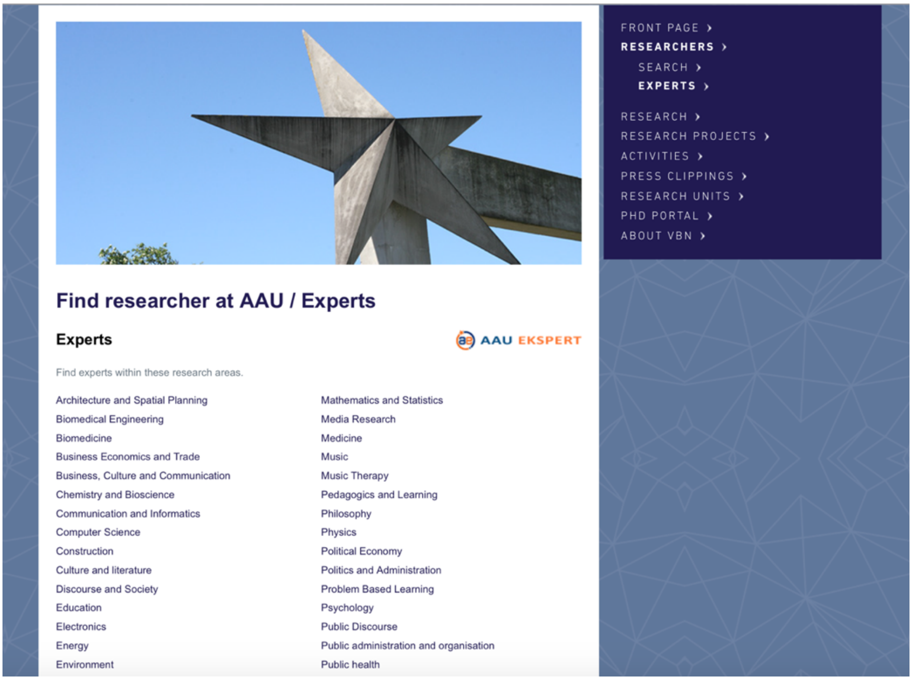

Figure 6.5. AAU Experts

Below is a list of controlled indexing terms regarding selected research areas. Each of these indexing terms can be clicked, which forwards you to a new subpage (with no other entry point; it is unavailable from the interface menu and from the home page) where the centre stage (section 5) lists experts alphabetically and through keywords related to the chosen research area, and the side-section lists a new line of controlled keywords consisting of subthemes to the chosen research area. When clicking one of these, a list of researchers (AAU experts) appears in the main section.

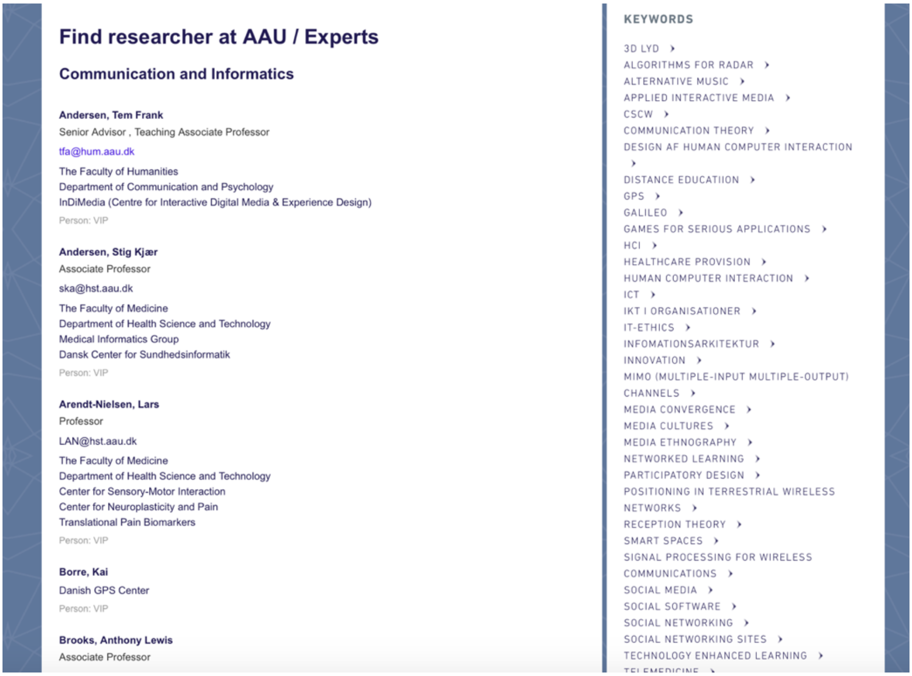

Figure 6.6. Controlled indexing terms related to research category

When clicking on any given researcher, you access a researcher profile with controlled indexing words on, for example, affiliations, research, activities, research projects, press clippings, most frequently used journals, most frequent publishers and CVs. Sometimes, a map illustrating the geographical location of activities also appears. The consistency of what appears on the researcher profiles is rather poor, because several of these registration options are voluntary. The content, however, is interrelated in different ways. For example, you can access a researcher's research activities alone or you can see its relation to researchers, projects, press clippings and so on. You can even select 'View graph of relations' by which a network graph visualises relations across and between content.

6.2.1.3 Content category: Research

When you choose 'Research' from the interface menu, you are, once again, navigated to a subpage where different ways to categorise this type of content is presented.

Figure 6.7. Organisation of content about 'Research'

You can search for research using the search box (including an advanced search), or you can choose from a list containing 121.023 controlled search results. This list can be sorted several ways using metadata, i.e. by publication year, title or type. The types of research are controlled indexing words including: Contribution to Journal; Contribution to book/anthology/report/conference proceeding; Book/anthology/thesis/report; Contribution to newspaper; Working paper; Net publication; Contribution to conference without publisher/journal; Non-text contribution; Patent; Memorandum/exposition; Contribution to memorandum/exposition; Other. As illustrated in the expanded interface menu, you can also search for research by journals or publishers which brings up an alphabetical list of 10.041 and 6.537 search results respectively, sorted by title.

When clicking on a given indexing term within 'Research', a subpage containing all provided data on that specific indexing term appears.

Figure 6.8. Organisation of content about 'Researchers'

Different types of data on the individual research content is available: Information on researchers and their affiliations; details on the piece of research; download statistics; citation formats; attached documents (if open access is available); DOI; SFX; a graphical illustration of social media activity; and a list of publications from the same journal. Accordingly, users are offered multiple types of entries and data. However, once again, the consistency of this subject content is poor because of not all fields being mandatory during registration. For example, sometimes a list of uncontrolled keywords appears, but only if the researcher who reports the registration into VBN chooses to make such a list. Likewise, a publication abstract or note can appear, but only if a researcher has voluntarily registered it to the system. In that case, abstracts or notes are uncontrolled indexing terms and can vary in length and language. Further, whether or not open-access to journal papers is available is very inconsistent. In the form of a small icon, VBN provides users with an indication as to whether open-access is available or not:

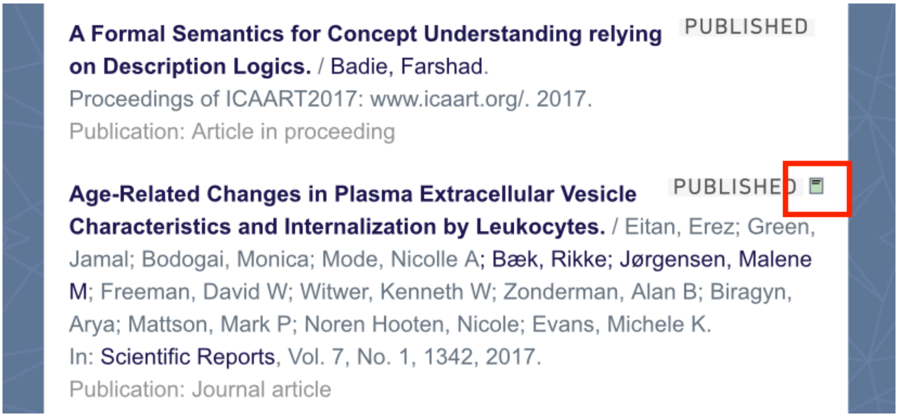

Figure 6.9. Icon representing open-access

The icon is there, although it might be subtle. If you click the icon, you are directed to a page from which the full-text version can be accessed.

6.2.1.4 Content category: Research projects

When you choose ‘Research projects’ from the interface menu, you are navigated to a subpage similar to the ones mentioned previously, where different ways to categorise this type of content is presented. You can search for research projects using the search box (including an advanced search); or you can choose from a list containing 6.483 controlled search results, which can be sorted by start date, created date or title (controlled indexing terms). Another option is to click on ‘Browse’ in the extended interface menu, which causes a new side-section containing controlled indexing terms to appear.

Figure 6.10. Controlled indexing terms related to 'Research Projects'

However, clicking any one of these indexing terms gives no search results: No content is connected to any of them. It appears to be a phased-out feature at the time of this analysis, however, it is a useless functionality which only confuses the user.

There are three types of controlled indexing terms available related to 'Research projects': Research, Consultancy and Other. To each of these, a number of controlled (i.e. if it is a collaborative project) and uncontrolled (i.e. results, notes or keywords) indexing terms can be reported. However, once again, which and how much data is registered is very inconsistent, because not all fields are mandatory.

6.2.1.5 Content category: Activities

When you choose 'Activities' from the interface menu, you are navigated to a subpage similar to the ones mentioned previously, which presents different ways to categorise this type of content. You can search for activities using the search box (including an advanced search), or you can choose from a list containing 34.780 controlled search results, which can be sorted by start date, title or type. There are 30 different controlled indexing terms regarding activities. To each of these, a number of controlled and uncontrolled indexing terms can be reported. However, once again it is very inconsistent which and how much data is reported and how many activities have been registered.

6.2.1.6 Content data: Press clippings

When you choose 'Press clippings' from the interface menu, you are navigated to a subpage similar to the ones mentioned previously, where different ways to categorise this type of content are presented. You can search for press clippings using the search box (including an advanced search), or you can choose from a list containing 72.638 controlled search results, which can be sorted by date or title.

6.2.1.7 Content data: Research units

When you choose 'Research units' from the interface menu, you are navigated to a subpage similar to the ones mentioned previously, where a list of research units to choose from (controlled indexing terms) appears. Clicking any one of these, or their subunits, will direct you to a subpage similar to the previously-mentioned ones, where different data on the specific content and their relations appears.

As the expanded interface menu in Figure 6.11 illustrates, you can also choose to access this type of content categorised according to 'Research centres' or 'All alphabetically'. In both cases, a list with hyperlinks that directs you to subpages similar to the previously-mentioned ones appears in the main section.

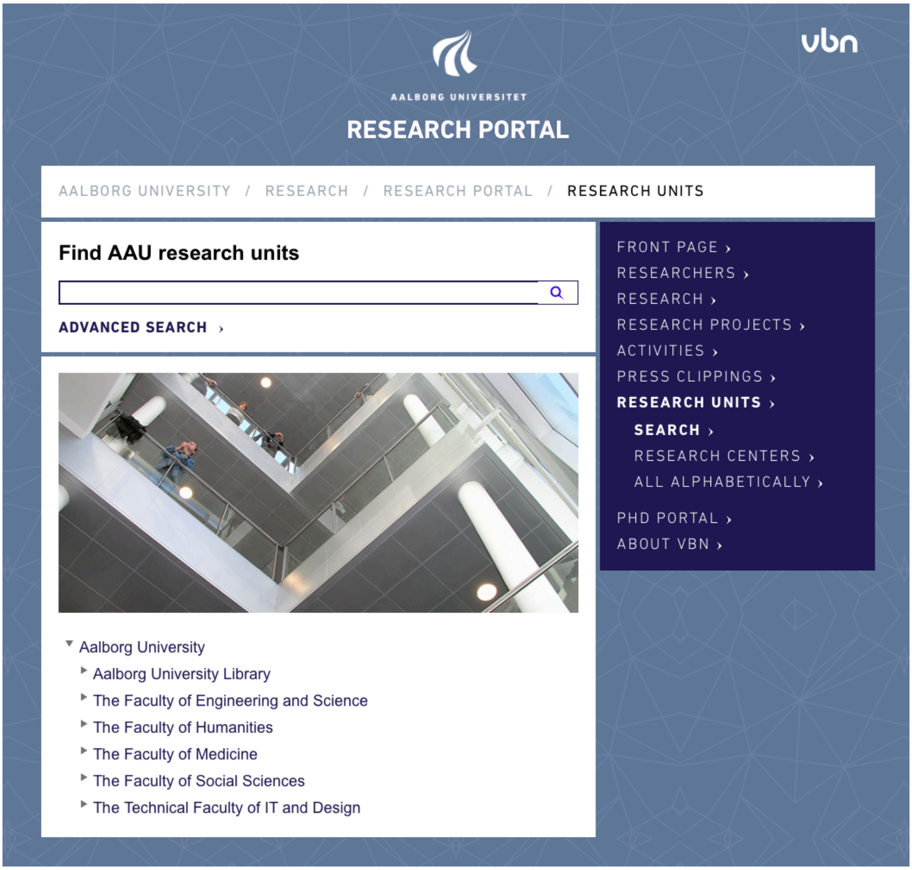

Figure 6.11. Organisation of content about 'Research units'

6.2.2 SUMMARY

As this study has exemplified, different types of data are available in VBN. It is these types of data that constitute the existing scientific knowledge. The Development phase of the thesis will experiment with disseminating this scientific knowledge. Accordingly, summarising its characteristics is profitable. Existing scientific knowledge as it is organised and presented in VBN can be accessed according to the following content categories: 'Researchers', 'Research', 'Research projects', 'Activities', 'Press clippings' and 'Research units'. These content categories are interrelated and their relations can also be used as entries across the different content categories. Each of these content categories are controlled indexing terms, which consist of different types of content such as uncontrolled indexing terms (i.e. publication abstracts or keywords), graphs of relations, full-text versions (when available) and graphs over social media activity. When the Development phase explores how a generic pathway can disseminate existing scientific knowledge, all of these types of data and products can be used as examples.

6.2.3 DISCUSSING THE PRESENTATION AND ORGANISATION OF SCIENTIFIC KNOWLEDGE IN VBN RELATED TO SMEs

Knowing that the VBN Editorial Office has expressed a desire to improve SMEs' use of the VBN interface – and taking the insights from Study A and Study B about the situation and preferences of SMEs into account – I do feel it appropriate to make a critical assessment of the way the content is structured and organised in VBN.

As Study A and Study B showed, SMEs are under constant time, resource and development pressure. They look for new knowledge primarily for one of two reasons: (1) when they have to solve a pressing problem or task, thus looking for precise information or (2) when their task is to update their knowledge and find inspiration by looking for new ideas, technologies, processes and products. To SMEs, the search for new knowledge must be easy and effective and the knowledge itself must be short, specific, practically usable and result-oriented. Bearing these circumstances in mind, VBN does not necessarily organise scientific knowledge in a way that makes sense to SMEs. As mentioned earlier in this chapter, the web interface of VBN is primarily text-based. While this might be an intentional decision, it does not correlate very well with SMEs' preferences. Interpreting the situation of SMEs, more visual elements and less text could be beneficial. Furthermore, VBN does not provide information or instructions on how the existing scientific knowledge can be converted into practice and used to solve work-related problems. Because of this, SMEs could have difficulties identifying its potential value. Also, the organisation of knowledge in VBN is neither easy nor short. On the contrary, VBN can be said to require of its users that they either know what they are looking for, know the indexing guidelines and the vocabulary used, or have a lot of time for finding that out. The lists of content related to the search results of the different content categories are very long (up to 121.023 results) and they offer limited ways to categorise the results. A direct search via the search box is the quickest way to a precise search result, but it does require that you know what to type in. SMEs might not. Further, VBN does not contain a data type where there is room for presenting how a given piece of content can be used for solving work-related problems, nor does the text-heavy design or long lists of results invite SMEs to be inspired. Accordingly, to SMEs, VBN is not necessarily an easy nor effective interface to use, by which it is no surprise if they deselect it as a knowledge source. Although Study B did not address this question, the fact that VBN does not figure as a code under the thematic analysis of 'Channels to find new knowledge' in Section 5.3.2 indicates that VBN is in fact not one of SMEs' knowledge sources. However, from the collected data, it is not possible for me to explain why that is.

VBN does not clearly illustrate what subjects of scientific knowledge might be of relevance to SMEs. In VBN, the content regards types of scientific product and not work-related topics for SMEs to search on. The controlled indexing terms that are used on a few subpages (see Figure 6.6 and Figure 6.10) are examples of scientific knowledge being organised according to topics, which might be easier for SMEs to navigate in. However, the available Pure data does not allow for information on 'how to convert it into practice' to be reported. Based on the findings from Study B, that could be expected to be desirable to SMEs. However, a voluntary and uncontrolled indexing term regarding 'results' is available to some of the content categories, which is a thing SMEs in Study B expressed (with other words) would be useful to them (see Figure 5.12). The use of this field, however, appears to be extremely inconsistent.

All in all, the content and organisation of knowledge in VBN bears witness to being primarily targeted at groups other than SMEs, i.e. researchers. This relates to what was previously stated, that universities are using Research Information Management Systems not only because they *want* to provide knowledge to business and society, they are also increasingly *obliged* to document their scientific endeavours. During meetings with the VBN Editorial Office, they also expressed an orientation towards peer-to-peer to be their primary (if not only) focus.

However, VBN is a functioning and graphically-attractive web interface and it does make scientific knowledge available, which, as stated earlier, is its defined goal. Related to the research aim of the thesis, the intention is to make the scientific knowledge not only *available* but to ensure that it is also *found* and *used* by SMEs. Related to SMEs' (potential) use of VBN, this analysis has pointed out some (potential) problems. Whether or not SMEs can *find* VBN is another discussion. According to Armbruster and Romary (2010), research repositories might have many functionalities, but they will not be accepted and used in the long term unless they first and foremost serve scholarly communication. Accordingly, communicating their existence is an important task. A quote from one of the respondents in Study B exemplifies this:

Interviewer: "Would you go to VBN, the research portal of AAU?" Respondent: "No, I actually do not think that I would. It is a really good idea, but I do not think that I would. Maybe mostly because I have not been introduced to it. It seems a bit foreign to me. It seems difficult somehow because I do not know what it does or what it can. If I was told what it does and what it can, then I am pretty sure that I would."	Respondent 13 (Appendix 2.16)

This indicates that SMEs' use of scientific knowledge is not only potentially challenged by the way knowledge is organised and presented in the web interface, but also by a lack of communication about the existence, purpose and use of VBN. This relates to the communicative principle of promotion, which was deduced in Section 5.5: The university must be the proactive party that promotes scientific knowledge (and their channels) to SMEs.

6.3 FINAL REMARKS

The goal of this study has been to explore and describe the characteristics and the organisation of existing scientific knowledge in the VBN Research Information Management System. However, this study does not provide insights into what SMEs actually think of VBN, nor of how (and if) they use it. Rather, the study has been a descriptive analysis. It has lacked the ability to *explain* some of the points described and analysed. In that regard, supplementing the study by creating other types of qualitative data that provide access to the thoughts behind the interface or the use thereof could have provided interesting perspectives. Further, I have used articulations from the VBN Editorial Office as documentation of the fact that SMEs are not using VBN as much as they (VBN) would want. This could also be examined, for example, using data from Google Analytics, which could be an idea for further studies. Instead, I have used the insights from Study B to discuss SMEs' *possible* attitudes towards VBN. The next chapter initiates the Development phase of the thesis, and here SMEs will be invited to contribute their ideas for the organisation and presentation of scientific knowledge in a generic pathway targeted at SMEs.

CHAPTER 7: WORKSHOP STUDY

This chapter is the first part of the Development phase of the thesis. Accordingly, the focus will now change from examining and analysing to developing. However, the aim is still mainly of an explorative character, although this phase is oriented towards *acting on* the research conducted in the first part of the thesis. As mentioned in Section 3.2.4, acting on research is an important part of an interpretative study, because its results are seen as a meaningful and important outcome of inquiry processes (Lincoln & Guba, 2000). Therefore, this and the following chapters will explore how the understandings acquired in the Examination phase can be used as the foundation for a development process, which will provide another type of insight related to the answer to the research question. This will be done by developing (and later evaluating) an actual generic pathway that *exemplifies* and *concretises* how existing scientific knowledge can be disseminated to SMEs using generic pathways, which is the research question of the thesis (see Section 1.6).

The first study of the Development phase is the Workshop Study. As mentioned in Section 3.3.4, the purpose of the Workshop Study was to generate conceptual ideas for an actual generic pathway. The Workshop Study thus seeks to contemplate an answer to the fifth sub-question (SQ5): How can a generic pathway disseminate scientific knowledge based on an understanding of the situation and preferences of SMEs?

The Workshop Study and its idea generation is based on intersubjective perspectives of SMEs. Because the overall methodology of this thesis is characterised as interpretive (see Section 3.2), and because the thesis' research logic is to avoid predeterminations and allow categories of inquiry to be determined by the actors and the situation and thus be developed as a function of the actual research undertaken (Dahler-Larsen, 2008), it is the job of the researcher to gain access to people's 'common-sense thinking' and to interpret their actions and their social world from their point of view. In other words: To explore and understand social practices through subjective perspectives. Further, because dissemination was characterised as a specific type of communication (Chapter 2), an understanding of universities and SMEs being equally able to influence the process and both play an active role in determining the meaning of the message (see Section 2.2.2) is prevalent. This understanding entails that scientific knowledge cannot simply be taken from a generic pathway and put into SMEs. If attempting to create an information-pull rather than a science-push (Bielak et al., 2008), it is essential to understand what SMEs need from this communication, which is why basing the idea generation on their perspectives and common-sense thinking is valuable.

A Workshop Study is a research method that allows for this. As mentioned in Section 3.3.4, a workshop study is a research method that operates with users in design processes in order to ground innovation in their needs and values (Kanstrup & Bertelsen, 2011). Furthermore, a workshop study makes it possible to gain access to the shared beliefs, situated meanings and common-sense thinking of relevant stakeholders. Conducting a workshop study is a method to operate with users in design processes and to ground innovation in their needs and values (Kanstrup & Bertelsen, 2011). By that, the Workshop Study ensures that the Development phase of the thesis is based on intersubjective understandings and an interpretation of the social reality of relevant stakeholders.

As was the case with Study B, SMEs were also the primary relevant stakeholders in this study. However, as mentioned by Muller (2003), a workshop brings together diverse stakeholders to do common work, to produce common outcomes, and to develop a plan of joint action. Accordingly, other stakeholders were also deemed relevant to participate in the Workshop Study and were therefore also invited. These included representatives from the university, the VBN Editorial Offices and Elsevier. A total of 16 stakeholders participated in the Workshop Study, which also included me and the project manager, the UX designer and the digital designer from the professional digital agency. See Section 3.3.4 for an overview of the participating SMEs.

7.1 PROCEDURE OF THE WORKSHOP

On February 3rd, 2016, all participants met up at the conference centre. The participants had been informed of the context of the workshop via e-mail and some of them had also participated in Study B, thus they already knew about the PhD project. The workshop consisted of an introduction and three iterations aimed at development: (1) A silent brainstorm, (2) card-sorting assignments and (3) a 'dream' phase. All iterations built on each other, which means that the participants used the results/material from the first iteration to begin the second iteration, and the results/material of the second iteration to begin the third. For the two last iterations, the participants were divided into two groups, each containing different types of participants. As mentioned in Section 3.3.4, all iterations were planned and facilitated by the UX designer from the professional digital agency. I participated in all three iterations, although I intentionally kept a low profile by letting the participants do the talking in order to influence the processes as little as possible.

7.1.1 INTRODUCTION TO THE WORKSHOP

The workshop began with an introductory presentation held by me. The context of the workshop was orally introduced followed by a short presentation of the PhD project and its research aim. Here, Study B and some of its results were introduced in order to show what knowledge was already acquired. This made it possible for all contestants to get a common starting point and to consider whether or not they felt the same way as the SMEs from Study B had expressed. For example, some of the statistical representations of data from Study B was included to give a quick overview of the results. Further, quotes from the study were presented in order to exemplify some of the problems identified by SMEs, i.e. that "I rarely have time for it at work. Then it is called free time. Interested free time" (Respondent 24, Appendix 2.27) or "But it is really difficult for us to take out half a day because we have deadlines" (Respondent 9, Appendix 2.12).

The introductory presentation also included a visualisation of the types of scientific knowledge that existed in VBN (which was analysed in Chapter 6) and stressed that the workshop was oriented towards exploring new ways of presenting and structuring this data. They were told that determining (and partly designing) this 'new way' was up to them. The important thing was to find out *how* scientific knowledge should be presented and structured according to them; how it should be done in order for them to find it easier, more appealing, more relevant and so on to use in their everyday working assignments.

Finally, all participants were introduced and their different roles were explained. There were seven participants from different SMEs who represented the main target group of the PhD project (and the workshop) and contributed with their perspectives on what they needed from a new solution. There were three participants from the professional digital agency who were there to facilitate the development exercises. There were two professors from AAU, a chief consultant from VBN and two participants from Elsevier who were there to contribute with their different perspectives on the problem area. After that, time was allowed for matching expectations and for the participants to comment on the introduction or ask questions.

See the full introductory presentation in Appendix 3.1.

7.1.2 SILENT BRAINSTORM

The first iteration of the workshop was a silent brainstorm. Here, participants could sit alone and write down their ideas anonymously. It was thought of as a 'breaking the ice' brainstorm. It began with each participant being given Post-it notes and a pencil. Individually they were to write down one or more notes about what a generic pathway presenting scientific knowledge specifically to SMEs should offer in order for them to use it. It could be anything from the information they would like it to provide to what functionalities they emphasised. They were given approximately five minutes for this. After that, they had to put their Post-its up on a shared board, thus collecting all ideas in one place. Finally, they were invited (but not forced) to each spend 10 seconds on orally presenting what they had written down.

7.1.3 CARD-SORTING ASSIGNMENTS

The next phase consisted of two card-sorting exercises. The first focussed on 'functionality' and the second focussed on 'information'. The two exercises followed the same procedure. First, the participants were given more Post-its and were instructed to work together and write down all the (1) functionalities and then (2) types of information they could think of, i.e. 'profiles' or 'news' (information) or 'filtration of news' (functionality). Each group was given one big poster which had six different headers (with the numbers one to six). The participants were then instructed to gather all their notes and sort them according to how relevant/important they found it as a group (1-2 being 'need to have', 3-4 being 'nice to have', 5-6 being 'irrelevant'). This was done two times. They were given approximately 30 minutes for each of the card-sorting assignments. After that, the two groups presented their posters with features and information to each other. They were told to focus on the most important aspects.

7.1.4 DREAM PHASE

Using the poster with all the Post-its from the previous assignment as inspiration, the participants were now instructed to design their dream (ideal) pathway/interface. The assignment was somewhat open for interpretation. They were simply told to use their imagination and creativity to design the interface of their dreams. For example, the groups could choose to draw it, thus visualising the structure and the content, or they could choose to keep working with the Post-its. The idea behind this was that it would be less demanding to use the Post-its but that it would probably be less abstract to draw it out instead. Accordingly, an assumption was that it would be easier to get the participants to design through words than visually through drawings. However, both groups chose to draw, although they did find it challenging. The exercise ended with the two groups presenting their drawings to each other.

7.1.5 ROUND-OFF

The workshop ended with the participants being invited to share their thoughts on the exercises. Several of them asked follow-up questions about the

PhD project and expressed an interest in being kept up to date as the project progressed. Finally, all participants were invited to lunch to round-off the workshop.

7.2 RESULTS OF THE WORKSHOP STUDY

The different exercises of the workshop amounted to an understanding of what information and functionalities a generic pathway should provide in order for SMEs to find it useful and relevant. The data from the workshop is made up of pictures of the Post-its, the posters and the participants' drawings. This type of data is not as systematically and transparently documented as I could have hoped. The reason for this is that the workshop was mainly planned and facilitated by the professional digital agency. They were hired to facilitate the design of the generic pathway, and a workshop was part of their work process. For that reason, this study builds on their documentation of the data and on my own notes that I wrote down immediately after the workshop. In the following, I will sum up the results from the workshop. I will present the pictures of the data and from them I will outline some figures where the results are summarised and categorised. These figures are interpretations of the data. However, I have strived to translate the pictures directly into text and categorised it inductively according to emerging patterns. See Section 3.3.4 for reflections on this process. How the results of the Workshop Study are used as a foundation for the development of an actual generic pathway will be described in Chapter 8.

7.2.1 RESULTS OF THE SILENT BRAINSTORM

The silent brainstorm listed a number of ideas for what a generic interface presenting scientific knowledge specifically to SMEs should offer in order for SMEs to use it, which is illustrated in Figure 7.1 and Figure 7.2.

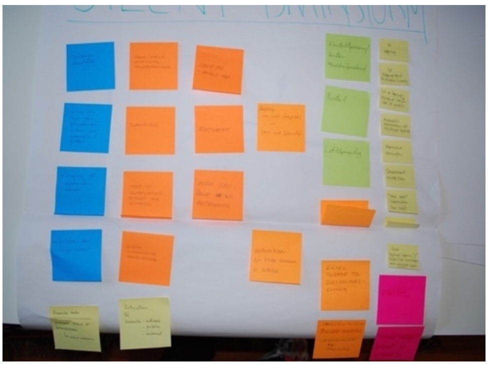

Figure 7.1. Silent brainstorm 1

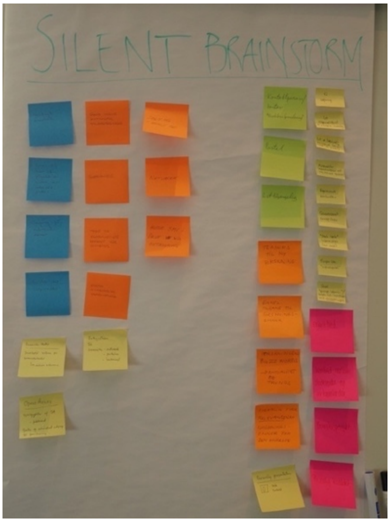

Figure 7.2. Silent brainstorm 2

These ideas can be categorised according to type (functionality/information), which were the two focus areas introduced by the digital agency. Table 7.1 sums up the results of the silent brainstorm.

Type	**Category**	**Explanation**
Functionalities	Contact	- Personal contact - Contact person or contact office - Contact between students and the enterprise
	Open-access	- Ensuring that full versions of papers are accessible - Open Access: Make open access visible and provide free and unrestricted access to all research
	Searching	- Searching on relevant topics - Simple search
	Notifications	- Notifications about new and relevant research
	Portal	- Function as a news portal
Information	Branch specific	- Branch specific headlines - Sorting content by branch codes (to ensure relevance) - Integration with branch networks, branch portals, branch intranets

	Relevant	- Top 10 research within a topic - Most cited research - Hot stuff (most read information)
	Personal	- Personal presentation - Providing an overview of the relevance of the research topics for the individual user - Tailored overview/introduction
	Inspirational	- Inspiring links - Teasers for new research - Research buzz words: topicality and trends - Innovation
	Easy	- Providing a quick overview - Easy access - Simplicity - Easy storage - Simple access to research topics
	Useable	- Links to where the scientific knowledge is used in practice - 'Problem statement'
	Eye-catching	- Has to 'leap out at you', break into the work day with relevant inputs
	Presented by topics	- Searching on relevant topics - Top 10 research within a topic - Providing an overview of the relevance of the research topics for the individual user

Table 7.1. Categorisation of the results of the silent brainstorm

Some of these categories overlap. Accordingly, some 'explanations' figure in relation to more than one category. What this figure illustrates is that while some specific functionalities can be identified, so can some characteristics for the information that must be provided. These characteristics can (and will) be refined and translated into a generic pathway. This will be explained in Chapter 8.

7.2.2 RESULTS OF THE CARD-SORTING EXERCISES

The card-sorting exercises produced a large amount of Post-its, which can be seen from Figure 7.3 and Figure 7.4. Several of them, however, turned out to be similar enough for the digital agency to group them together. Accordingly, they will only figure once in the following.

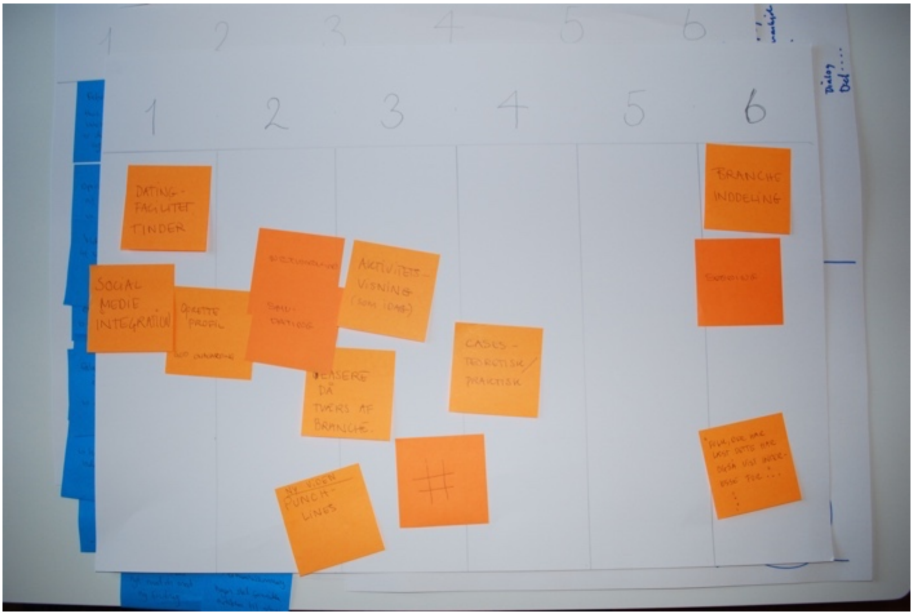

Figure 7.3. Card-sorting assignment, Group 1

Figure 7.4. Card-sorting assignment, Group 2

Table 7.2 sums up the results of the two card-sorting exercises. It categorises the data according to type (functionality/information) and illustrates what relevance assessment the participants gave it.

Type	**Need to have (1-2)**	**Nice to have (3-4)**	**Irrelevant (5-6)**
Functionality	Tinder-function (swiping through content)	Being able to sign up as a case enterprise	Downloading research papers
	Social media integration	Following researchers	Researcher profiles
		Integrating researchers' blogs	Linking to articles and networks on LinkedIn
	Networking	Linking to videnskab.dk	Searching
	Establish a profile	Indication of activity	Dividing branches
	Following a subject	Teasers across branches	
	SME dating	Hashtags	
	Type in a text that automatically generates keywords		
	A platform for all types of collaboration (internships, applications, students, contact)		
	Notifications of new relevant research		
	'Order a researcher' (to come and give a talk)		
	Quick and easy sharing through e-mail or other portals		
	Open-access		

	Contact person/support function (who can I call?)		
Information	Branch specific news (what is hot within this branch)	Language. Preferably in English	"People who read this also read this…"
	References (if this is interesting then this might also be interesting)	Abstracts: Maximum one page of text (subject and results)	
	Operationalising knowledge into disciplines and subject headings	Cases theoretical/practical	
	New knowledge (punch lines)		
	Filtration of content		
	Illustrations of how the research is shared on blogs and twitter		
	Visual material (make it clear)		
	Business-related summary		
	Results over methods		
	No research-based platitudes		
	Categorised by topics		
	Present scientific knowledge from crosswise universities		

Table 7.2. Results of the card-sorting assignments

As Table 7.2 shows, by far the most categories are rendered 'need to have' by the participants. It bears witness to it being a demanding task to disseminate scientific knowledge to SMEs and that several functionalities and information characteristics must be provided. The classical search function was rendered irrelevant during this assignment. The participants explained that while they would expect that an interface had a search field, it was not something they found important in this context, because they often would not know what to search for. Instead, they expressed that they wanted to be presented with topics and then move on from there.

7.2.3 RESULTS OF THE DREAM PHASE

The results of the dream phase were documented through drawings, one for each group. While the participants gave an oral presentation of their drawings, analysing this data material relies more on interpretation than the previous iterations, where the data material included mainly text.

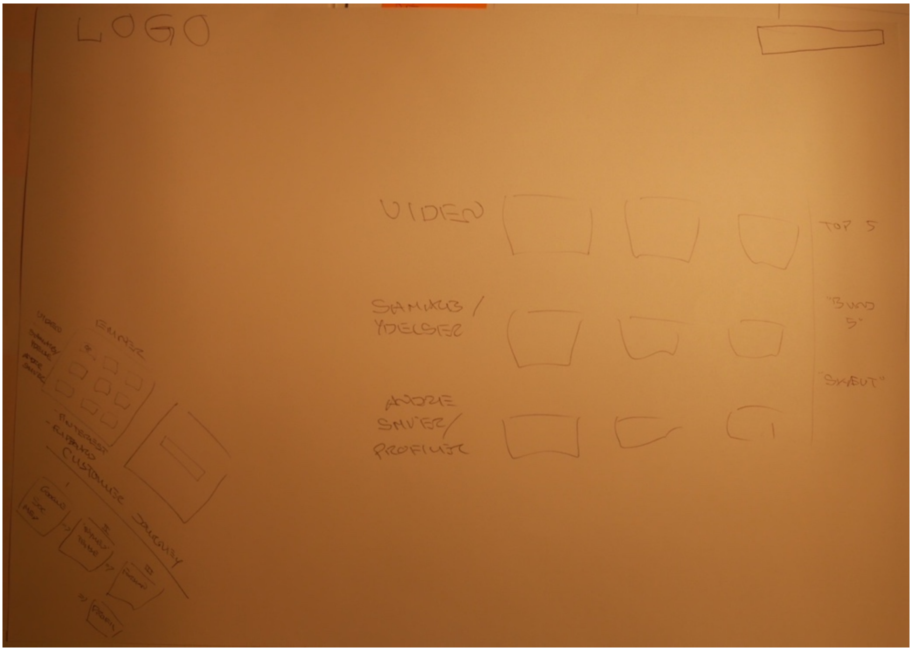

Figure 7.5. Drawing of a dream interface, Group 1

Figure 7.5 illustrates an interface where the content is presented in topics. They have drawn a quadrant consisting of nine topic-boxes, which can constitute the centre stage of an interface. Furthermore, they have noted down the words 'Pinterest' and 'Flipboard', which indicates that they see this presentation of topics as something inspirational.

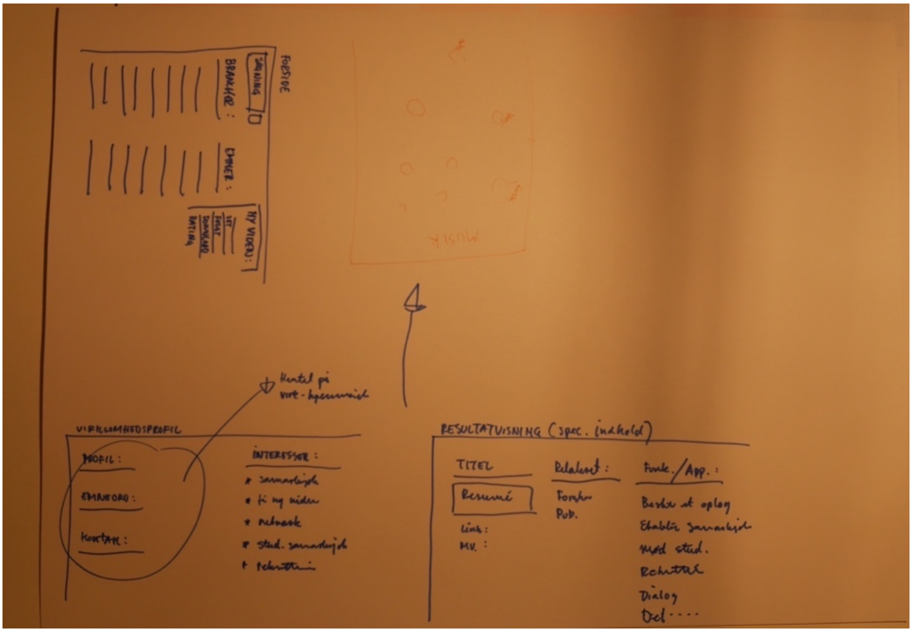

Figure 7.6. Drawing of a dream interface, Group 2

Figure 7.6 illustrates a conceptual idea involving universes. Group 2 drew (1) a front-page, (2) a profile-page for enterprises, (3) a sub-page with specified content, which would be the result of a search and (4) a box in the middle, which is harder to see because of the colour, where the title 'Music' and a lot of dots figure. To explain this drawing, I have to draw on my memory of the oral representation of it and on the notes I wrote down immediately after. While the front-page, the profile-page and the sub-page are pretty straight forward, the box titled 'Music' in the middle requires explanation. What the group of respondents explained was that it illustrated an idea of a 'universe'. So, if the topic was music, all the dots represented a type of content related to music. Their idea was that all content should be divided into topics and structured in 'universes', where all accessible content – both of a scientific and non-scientific character – should be gathered. The idea of accessing all existing content on a topic in one place was very appealing to them.

To sum up, the dream interfaces of both groups were structured around the idea of presenting the content in *topics*. They also stressed that they would definitively search for topics rather than persons, but that it would be nice to be offered a personal contact within a given topic. The idea of topics turned out to be central to the generic pathway which was developed after the workshop. I will elaborate on this and on the overall development of the generic pathway in the following chapter.

CHAPTER 8: DEVELOPING THE GENERIC PATHWAY

In this chapter, I will describe the development of the generic pathway and the thoughts behind it. To restate the purpose of developing this new generic pathway, it was to create a concrete way to exemplify and explore how scientific knowledge could be disseminated through generic pathways and based on the perspectives and preferences of SMEs. Developing the new pathway thus means to translate the results from Study B – including the communicative principles presented in Section 5.5 – and Study D into practice. Accordingly, this part of the thesis will involve *interpretation* of previous results. Explaining the thoughts behind the individual design elements will make this interpretation more valid. This means that I will continually draw references to the previous empirical studies of the thesis (Study B and Study D), which have been determinative to the design of all elements.

As mentioned earlier, the development of the generic pathway was done partly by the professional digital agency and partly by me and my supervisor. This also means that the data was processed by both them and us – and very much in collaboration. While my supervisor and I were responsible for interpreting the data, they were responsible for transforming it into design. Accordingly, while they designed the actual interface (navigation, presentation, design), we were responsible for determining the principles behind the design (deciding *why* navigation, presentation and design should look a certain way). I will explain these processes in the following.

Please note that the generic pathway presented in this chapter is the first version of a prototype and that a more final prototype will be presented in Chapter 10. Please also note that parts of the following work have been published in other versions in conference papers (Lykke et al., 2017b, 2017a).

8.1 PRINCIPLES OF EXPERIENCE DESIGN

To meet the preferences of SMEs, the principles of experience design were applied to the new generic pathway. This requires some explanation. The decision to incorporate the principles of experience design was brought on by both empirical and theoretical understandings provided throughout the studies of the thesis. As concluded in Chapter 6 and particularly discussed in Section 6.2.3, the way scientific knowledge is presented and organised in VBN does not correlate very well with the preferences of SMEs, which were analysed in Chapter 5. Some of the problems addressed in the analysis of VBN (Chapter 6) were that (1) VBN did not clearly illustrate what subjects of scientific knowledge might be of relevance to SMEs, (2) the web interface of VBN was primarily text-based, (3) VBN did not provide information or instructions on how the existing scientific knowledge could be converted into practice and used to solve work-related problems, and (4) VBN could be said to require of its users that they either know what they are looking for, know the indexing guidelines and the vocabulary used, or have a lot of time for finding that out. However, the data on SMEs' situation in relation to (scientific) knowledge as presented in Chapter 5 pointed out that SMEs needed 'more' from both presentation and organisation of scientific knowledge in order for it to become a valuable knowledge source to them. It required 'something else'. To briefly sum up, the results of Study B and Study D respectively demonstrated what preferences SMEs had regarding the presentation of scientific knowledge. Study B (Section 5.4) showed that scientific knowledge should be

- Easily and quickly accessible
- Personalised
- Exemplified and concretised (translated into practice)
- Result-oriented
- Short and specific
- Visually 'catching'
- Experience-based and specific (according to the business or market area)
- Allowing for 'being inspired'
- Easier to search for
- Promoted
- Practically oriented rather than theoretical
- And more

Study D (Table 7.1) showed that SMEs expressed a need for scientific knowledge to be

- Relevant
- Personal
- Inspirational
- Easy
- Usable
- Eye-catching
- And more

As these results indicate, principles and qualities such as utility and usability appeared to not be sufficient in order to get SMEs to use scientific knowledge as a knowledge source. This brought on the idea to incorporate other design principles that could change and improve SMEs' interaction with scientific knowledge. As I will show shortly, these characteristics expressed by SMEs regarding the presentation of scientific knowledge are similar to the principles of experience design. Experience design is meant to provoke a change in a user's state and behaviour (psychologically as well as emotionally) and thereby challenges previous perceptions and routines (cognitive aspects) (Jantzen, Vetner, & Bouchet, 2011). Such a challenge of previous perceptions and routines could potentially be relevant in the context of getting SMEs to consider scientific knowledge a valuable knowledge source. Therefore, based on the findings of the previous studies in the thesis, an underlying assumption is that the principles of experience can help disseminate scientific knowledge to SMEs through a generic pathway and thus provide relevant aspects for the answer to the research question (Section 1.6).

In the next section I will briefly describe the concept of experience and experience design in order to make it clear why and how experience dimensions have been applied in the presentation of scientific knowledge in the new generic pathway.

8.1.1 THE CONCEPT OF EXPERIENCE

Experience design builds on the concept of 'experience'. According to Dewey (1934), experience is the result, the sign and the reward of an interaction between an organism (an individual) and its surroundings. Similarly, Hassenzahl (2010, p. 3) states that "experience emerges from the intertwined works of perception, action, motivation, emotion, and cognition in dialogue with the world (place, time, people, and objects)". Experiences are thus dynamic. When an individual *reacts* to an interaction with his or her surroundings, an experience occurs. By that, an experience is a reaction to stimuli; it is a bodily process where senses are engaged and where emotions are aroused. In fact, emotions are at the centre of experience (Dewey, 1934; Hassenzahl, 2010; Jantzen et al., 2011; McCarthy & Wright, 2004).

> "An experience is an episode, a chunk of time that one went through—with sights and sounds, feelings and thoughts, motives and actions; they are closely knitted together, stored in memory, labeled, relived and communicated to others. An experience is a story, emerging from the dialogue of a person with her or his world through action". (Hassenzahl, 2010, p. 8)

As a noun, 'experience' has a dual meaning: It can be an awareness of an interaction with the surroundings (you can *have an experience*) and it can be a form of knowledge derived from such interaction (you can *be experienced*). Furthermore, 'experiencing' is not the same as 'an experience': "The latter is something with a beginning and end; it is something that can be named, whereas the former describes an ever-present stream" (Hassenzahl, 2010, p. 1). When we are interacting with our surroundings, we *have an experience* here and now, which can lead us to become more *experienced*. As a result, the concept of experience contains elements of both spontaneity and permanence (Gadamer, 2004). The process of experiencing (spontaneity) can lead us to learning something new (permanence).

An experience is thus a subjective phenomenon. It is the individual's reaction to its interaction with the surroundings that constitutes the spontaneous element of an experience. An experience "emerges through situations, objects, people, their interrelationships, and their relationship to the experientor, but it is created and remains in her or his head" (Hassenzahl, 2010, p. 9). Accordingly, different individuals (with different experiences) will react differently to the same interaction with the surroundings and thus have different experiences. Illustrating the psychological structure of the experience will explain this.

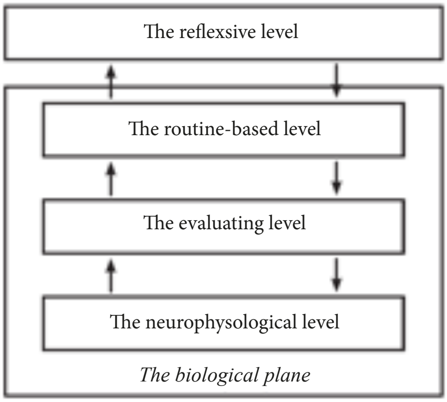

Figure 8.1. The psychological structure of the experience. Source: (Vetner & Jantzen, 2007, p. 36).

The model illustrates that having an experience is a bodily process that engages the senses and arouses emotions. Physiologically, experiences are characterised by sensual enjoyment and are caused by changes in the arousal of the individual, which can happen by either stimulation or relaxation (Jantzen & Vetner, 2008). On the biological level, which is primarily unconscious, an initiating stimulus (spontaneity) manifests itself as an impression on the neurophysiological level. This impression is evaluated emotionally and then establishes itself as bodily embedded knowledge (permanence). When this physical and emotional stimulus becomes conscious (the reflexive level), it turns into what Dewey (1934, p. 3) labelled a “refined” or “intensified” experience, which is a different type of experience than the everyday events and doings. In its vital sense, experience “is defined by those situations and episodes that we spontaneously refer to as being "real experiences"; those things of which we say in recalling them, "that was an experience"” (Dewey, 1934, p. 36). According to Jantzen (2013), this type of experience foregrounds extraordinary moments in the ordinary flow of occurrences. Here, expectations are important. Only when experiences deviate from what is expected, an altered awareness and a new understanding of a situation occurs. The ‘real’ or ‘refined’ experiences are the ones that can lead to reflection and thus to learning something new (permanence). Such experiences change, surprise and transform the individual (Jantzen et al., 2011). Depending on an individual’s previous experiences, reactions will vary, which is why no two people can have the exact same experience (Pine & Gilmore, 1999). Furthermore, because experiences are highly situated, they are never alike, neither between individuals nor within the individual having an experience (Hassenzahl, 2010). Accordingly, while two individuals cannot have the same experience, the same individual cannot have the same experience twice. Experiences may even fluctuate from one moment to the next. However, ‘experience patterns’ can be identified, which makes it possible to categorise experiences. For example, ‘searching for scientific knowledge’ could be an experience pattern, which could be changed and challenged through a new pathway.

Designing *for* experiences means to design in order to enable individuals to have an experience. It means to create value for the individual through bodily and emotional involvement. It means to design in order to challenge expectations and previous experiences, focusing on ‘pleasurability’ (Jantzen, 2013), that is the emotions brought on by the design rather than (only) the usability of the product. An experience design thus is a design (a product, a service, an event, a place) arranged in order to increase the chance for users to have a valuable experience (Jantzen et al., 2011). However, because an experience is a bodily process, a particular experience cannot be guaranteed through design; it can only be made more likely (Hassenzahl, 2010). Further, basing the development of a new generic pathway on the principles of experience design means to focus the design on provoking changes in the users’ state and behaviour (psychologically as well as emotionally) thus challenging their previous perceptions and routines (cognitive aspects) (Jantzen et al., 2011).

Related to the development of a new generic pathway, an assumption is that it could be profitable to design for a ‘refined’, pleasurable and meaningful experience. This could add that ‘something else and more’ I mentioned in Section 8.1, which SMEs expressed a need for in previous studies of the thesis.

Further, it could make it more likely for SMEs to find scientific knowledge relevant and thus be able to use it and learn from it. Getting SMEs to react differently to their interaction with scientific knowledge (spontaneity) and reflect upon it could enable a changed behaviour and new experiences (permanence) with this type of knowledge product, which is ultimately what the research of this thesis aims at. Designing for a refined and reflexive experience can be done by incorporating ten experience dimensions, which will be presented in the following.

8.1.2 TEN EXPERIENCE DIMENSIONS

Jantzen et al. (2011) deduced a set of ten dimensions for designing (and evaluating) users' experiences. Of the ten dimensions, the first seven are asserted to be the basic dimensions, which are psychologically derived and have a universal character (are independent of societal and cultural issues, economic agendas and technological innovations). The last three dimensions, on the other hand, are said to be culturally specific. In the following, I will briefly outline these in order to make it clear how experience dimensions have been applied in the presentation of scientific knowledge in the new generic pathway. However, it should be noted that the context of their work was very different from that of this thesis: They engaged in organising and designing experiences in the service sector, mainly in the physical space. Using the principles in the context of this thesis can be considered an experiment or an exploration of whether they are relevant in this connection.

First, because having an experience is a bodily process where senses are engaged and emotions aroused, a design has to be **involving**. It means that it has to engage and entertain the user and enhance positive moods. Physiologically, involvement implies a change in the body's arousal level, which can happen through, for example, stimulation or relaxation. Such changes may promote curiosity in the user, which can lead to a different (searching) behaviour. Second, a design has to invite the user to be **spontaneous**. It means that the user has to be diverted from his or her pre-planned goals. Third, a design has to be **interesting**. It means that it has to challenge the user's expectations (which are formed by prior experiences) thus making it possible for the familiar to become unfamiliar and for the user to be surprised. Fourth, a design has to be **relevant**. It means that the de-automatisation brought on by the un-familiarising of expectations has to remain understandable and manageable. It is important that the user is able to handle the unfamiliar and to manoeuvre through the design. Accordingly, these two dimensions (interesting and relevant) are interrelated: A relevant design without interest is not experiential and an interesting design without relevance can be too difficult to use. Experience-oriented design thus has to find a balance between these two dimensions.

As mentioned above, experiences can lead to **learning**, which is the fifth dimension. It means that a design has to expand the user's horizon, offering new perspectives and contributing to his or her development. The sixth dimension is **unique**, which is a quality in the design that should be perceived by the user. It means that a design should be exceptional, original, non-reproducible and new. This could be profitable and motivate the user. Seventh, a design has to be **interactive**. Because an experience is a bodily process, it is actively produced by the user. The core of experience design is therefore not only a matter of involvement, but also of user interaction. A design thus has to invite the user to actively participate and interact. Eighth, a design has to be **fun**. It means that it should be pleasurable to use and generate a feeling of joy in the user. Ninth, a design should be **close**. It means that the user should feel that the design addresses issues and concerns of significance to his or her life. Tenth and finally, a design should be **authentic**. It means that the user should feel that the design is 'for real' and that its intentions are trustworthy and reliable. The ten experience dimensions are summarised in Table 8.1.

Dimension	**Key issue**
Involving	Does the design engage its user physiologically and emotionally? Is it entertaining? Is it relaxing or exhilarating? Does it generate positive or negative emotions? Does the user get immersed in the design?
Spontaneous	Does the design invite its user to divert from goal-directed behaviour? Is it playful?
Interesting	Does the design challenge its user's expectations? Does it present something unexpected, an obstacle? Is it surprising? Does it pose a riddle to be solved?
Relevant	Does the design enable its user to activate existing cognitive structures? Does it relate to previous experiences? Is it a riddle that can be solved in a meaningful manner?
Learning	Does the design empower its user? Does it expand the user's horizon? Does it contribute to (self-)development, to identity and habit formation?
Unique	Does the design present something exceptional? Is it original? Is the design something not encountered before or something that cannot be encountered anywhere else?
Interactive	Does the design make its user feel that he or she is an active participant in the design? Does it invite the user to become co-creators or co-designers?

Fun	Does the design generate a feeling of joy in its user? Is it pleasurable?
Close	Does the design address issues that its user finds important? Is it tailored to meet the user's specific demands? Is it personalised?
Authentic	Does the design evoke an impression of sincerity in its user? Is it true to its purpose?

Table 8.1. Ten experience dimensions. Source: (Lykke & Jantzen, 2016)

The experience dimensions can be used as a frame to design (and evaluate) users' experiences. As Table 8.1 bears witness to, there are several similarities between these dimensions and SMEs' preferences for the representation of scientific knowledge as summarised in Section 8.1. For example, the participants in the Workshop Study expressed that scientific knowledge should be inspirational, which could be achieved by making it interesting, relevant and fun. The respondents also mentioned 'relevant, 'personal' and 'eye-catching', which are also strongly related to the experience dimensions. Furthermore, the remaining preferences of SMEs (see Section 8.1) could be accommodated through the experience dimensions, which I will elaborate on in the following.

8.2 THE IDEA BEHIND THE NEW GENERIC PATHWAY

The basic idea for a new generic pathway was an online interface where scientific knowledge would be disseminated according to the situation and preferences of SMEs. Or to use the terminology of the communication theory from Chapter 2, the interface is the channel that will make it possible to exchange the message (scientific knowledge) and make its meaning common to SMEs. As mentioned earlier in the thesis, it was a defined condition for the PhD project that it explored the dissemination of *existing* scientific knowledge from VBN as a case. By that, it was given from the get-go that the new generic pathway should be able to more or less automatically draw data from VBN (see Chapter 6). Choosing to design a web-interface might not be the most surprising or revolutionary idea, but it was, however, something several respondents expressed a desire for during both Study B (see for example Figure 5.12) and Study D, and something that would accommodate several of the perspectives on SMEs' situations in relation to knowledge, which I will clarify in the following. Furthermore, an interface is an example of an intermediary, which was mentioned as a solution to several of the barriers analysed in the Literature Study (see Section 4.2.2).

When developing a new interface, the focus was on *how* scientific knowledge could be presented and organised in order to be deemed accessible, understandable, relevant and usable by SMEs and thus become a more preferred knowledge source to them. This is an interpretation of how the dissemination process can be 'optimised', which I mentioned an orientation towards in Section 1.6. Figure 8.2 and Figure 8.3 illustrate the front page and a sub-page of the interface.

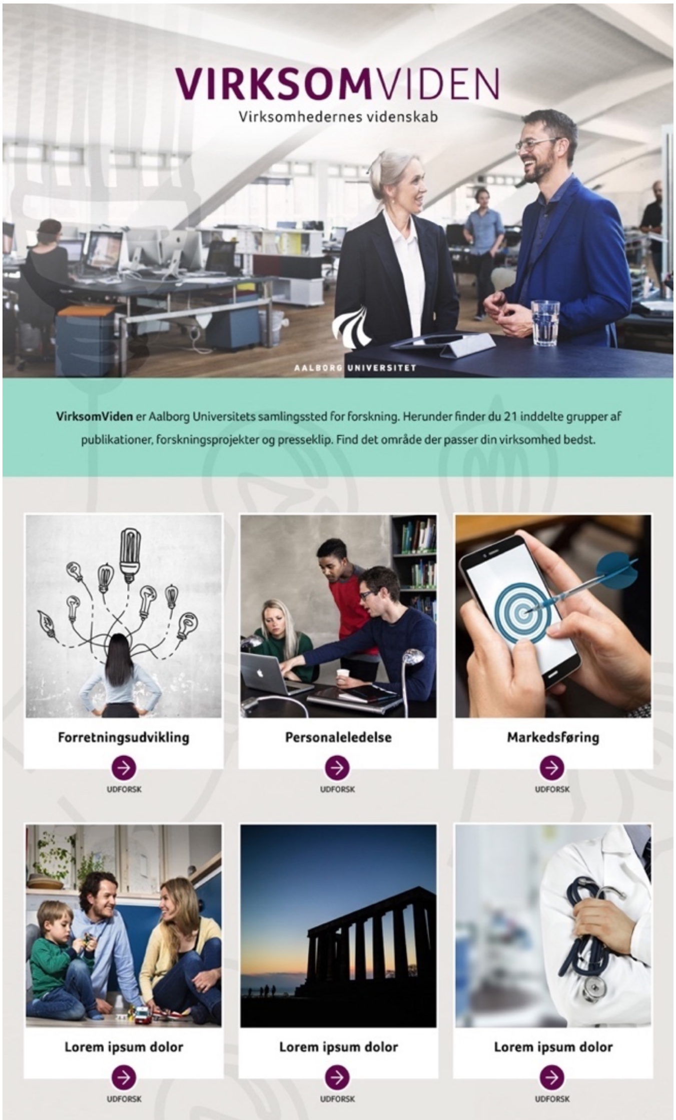

Figure 8.2. Front page of the interface

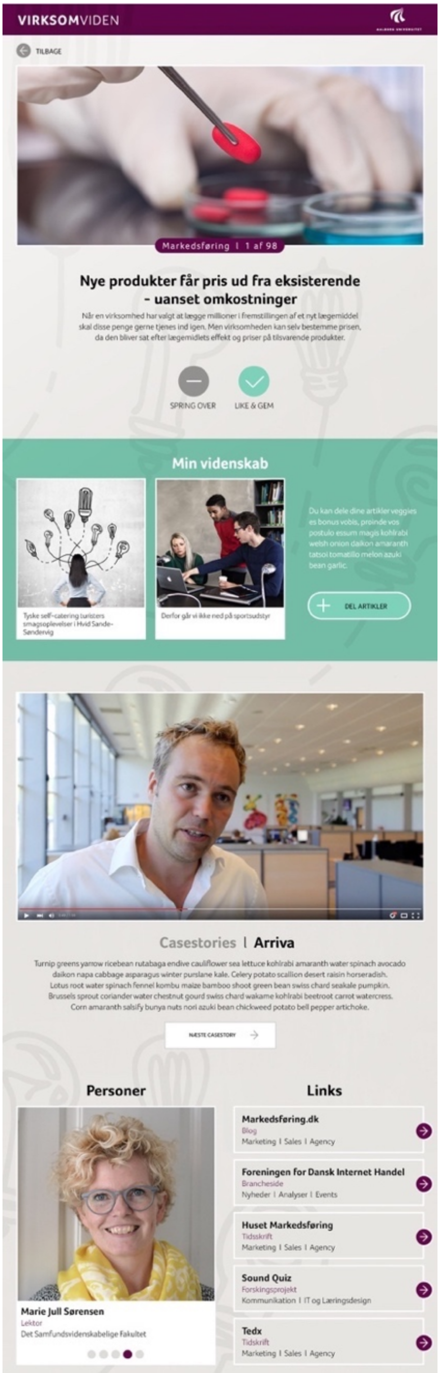

Figure 8.3. Sub-page of the interface

The development and design phases involved considerations about: (1) Categorisation of scientific knowledge, (2) Types of information and functionalities, (3) Titles and annotations and (4) Design. The following description of the interface will be structured according to these different types of elements.

8.2.1 CATEGORISATION OF SCIENTIFIC KNOWLEDGE

Study D contributed with the idea to present scientific knowledge in subjects and themes rather than according to types of material, i.e. researchers, publications or projects, as is currently done in VBN (see Chapter 6). Accordingly, categorising scientific knowledge in themes/subjects is a different way of organising, concretising and providing scientific knowledge to SMEs, conferring the communicative principles (Section 5.5). A specific idea from the Workshop Study was to gather all types of content in a 'thematic universe', where SMEs could access all available content of both a scientific and non-scientific character (see Section7.2.3). This idea of being able to access all existing content on a given topic in one place was very appealing to them. It would be a way for them to access scientific knowledge when they (1) were searching for precise information in order to solve a pressing problem or task, which was labelled the purposeful search or, (2) were looking for inspiration in order to update their knowledge by looking for new ideas, technologies, processes and products, which was labelled the inspirational search (and was also referred to as 'shopping for scientific knowledge'). As addressed in Section 5.3.3, these were the two main incentives for searching for new knowledge mentioned by SMEs. Inviting for both types of search behaviour could be profitable.

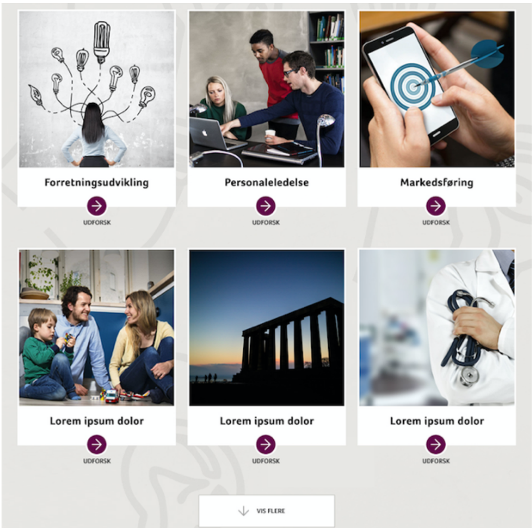

Figure 8.4. Categorisation of scientific knowledge in the interface

As Figure 8.4 illustrates, the idea was to present a number of subjects in 'boxes' with a title in layman's terminology, a picture reflecting the task or problem and an 'Explore' button that allows and encourages the user to immediately click and explore scientific publications within the subject area. Further, the subjects are unrelated and organised randomly, as opposed to more traditional forms of organisation (e.g. hierarchical or facetted). Findings from the Workshop Study indicated that SMEs preferred informal browsing, which they are familiar with from Instagram and other social media formats, that allows them to scroll quickly through the content.

The idea for this categorisation of scientific knowledge came mainly from Study D, where information 'Categorised by topics' was rendered need-to-have (Table 7.2), but also from Study B where it was pointed out that scientific knowledge should be organised in a way that makes sense to SMEs. Presenting the scientific knowledge as illustrated in Figure 8.4 could enable SMEs to (1) purposively choose a specific subject or (2) to be inspired and find subjects they did not know they were looking for or needed. In other words, the intention behind this organisation was to enable both focussed access to scientific knowledge in relation to SMEs' everyday problems and unfocussed browsing for new ideas. Clicking any of these boxes would lead to a subpage where a 'thematic universe' would appear. In total, this categorisation of scientific knowledge builds on the experience dimension of **closeness** and **spontaneity**, because it is organised according to the everyday working tasks and browsing behaviour of SMEs.

For this first prototype of the interface, we decided to choose subjects with relevance to SMEs as they are broadly perceived. That is, subjects regarding the overall business conduct that could be deemed relevant across trades, i.e. business development, management or marketing. There were several reasons for this. First, it relates to the understanding that was identified in Study B (Section 5.3.7.1), that SMEs tended to think of the relevance of scientific knowledge in relation to their core product and development and therefore often deemed scientific knowledge irrelevant, because they believe that they themselves are the experts on this. Secondly, it was not possible for us to develop a prototype that accounted for subjects related to all SMEs' core products. Although we were aware that this would be the type of knowledge that SMEs were most interested in, on a prototype basis it was unrealistic. Therefore, choosing subjects related to an overall business conduct seemed like an obvious choice. Thirdly, as mentioned in Section 1.7, I had an assumption that knowledge from the natural sciences would generally be considered more relevant to disseminate than knowledge from the social sciences and especially from the humanities. As a consequence of this assumption, using subjects on overall business conduct was a way to ensure that other types of scientific knowledge would be tested. In total, choosing to present subjects with relevance to an overall conduct of business might be a way of showing SMEs what scientific knowledge could possibly contribute with, also related to business-related areas other than their core development. It might also help them to realise that while they themselves are experts on their core development, they do not always know best themselves on all areas and that scientific knowledge could be of value on subjects other than what they immediately think of. This would improve their assessment of **relevance** and **interest** (experience dimensions).

When we chose to categorise and present the scientific knowledge according to subjects, we simultaneously deselected representing it by branches, which was also a popular preference in Study D. However, our assessment was that it should not be up to the university to decide what content or subjects could be relevant to which branch or trade. When presenting the scientific knowledge in subjects/themes, this assessment could be left up to the SMEs themselves.

8.2.2 TYPES OF INFORMATION AND FUNCTIONALITIES

The idea to collect all types of content about a subject/theme was adopted for the interface. This idea was supported by Study B, where findings illustrated that SMEs use a large variety of channels and knowledge types when looking for knowledge. This multimodality (regarding channels, words, pictures, sounds and navigational routes) is a way to ensure **involvement** (experience dimension). When clicking any given subject box on the front page, the user would be directed to a subpage where the thematic universe of that subject would unfold. Here, we presented different types of information/content in different modules related to that subject. Four modules were created for the sub-pages: (1) Publications, (2) Case stories, (3) Researchers and (4) Other links.

The 'publication' module was presented as the first one on the sub-page. Introducing it at the top of the sub-page, thus giving it the most prominent place, was intentional in order to stress the importance of this type of content. As illustrated in Figure 8.5, the idea of the publication module was to make the presentation of scientific publications visual and easy to decode. The text is downgraded and kept to a minimum and instead the importance of a 'descriptive' picture was upgraded. This was done because of several points raised by both Study B and Study D, for example what was analysed in Section 5.3.7.2, that scientific knowledge is often 'Too theoretical/specialised, not concrete/practicable'. The analysis showed that for SMEs to be able to implement scientific knowledge to their own situation and issues, they needed scientific knowledge to be practically oriented rather than theoretical, and general rather than too specific. They needed it to be application-oriented and usable to solve specific needs. The quotes from this analysis also stressed that SMEs needed "quick information" (Respondent 4) and that their attention would be caught "100 percent better visually" (Respondent 10). Accordingly, presenting scientific knowledge as illustrated in Figure 8.5 is a way to reorganise (communicative principle) scientific knowledge according to the preferences of SMEs. Furthermore, presenting scientific knowledge in subjects and then one piece of content at a time as illustrated in Figure 8.4 is a way to get around SMEs' experiencing that 'Too much material is available' (Section 5.3.4) and making it very concrete (communicative principle).

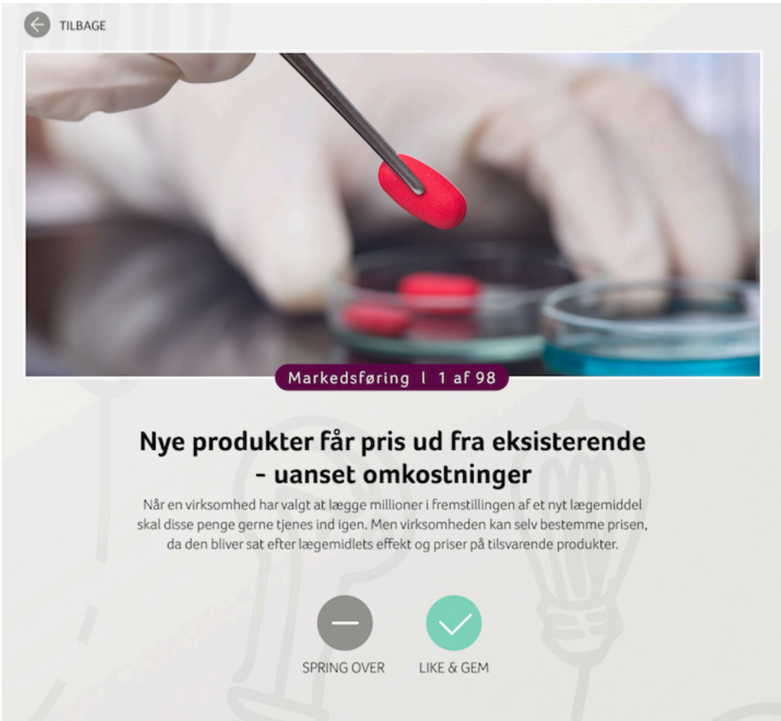

Figure 8.5. The 'Publication' module of the interface

The text accompanying the picture was kept short, concrete and result-oriented, which I will elaborate on when reflecting on 'Titles and annotations'. When clicking on a publication the user would be directed to the content page in VBN. The functionality of this module was that users could click on one of two buttons: 'Skip' or 'Like and save'. This functionality was inspired by results from Study D, where participants considered a 'Tinder-function', where you could swipe through content, as a need-to-have (see Table 7.2). If the user clicked ‘Skip’, a new publication would appear; if the user clicked ‘Like and save’, the publication would be saved in ‘My science’, which was a sub-module to the publication module. In total, this functionality was **unique** (in the context of scientific knowledge) and **interactive** and it invited the users to be **spontaneous** (experience dimensions), potentially browsing through more publications than planned. Further, our hope was that it would be rendered **fun** (experience dimension), thus motivating SMEs to continuing browsing for scientific knowledge.

Figure 8.6. The ‘My science’ module of the interface

In ‘My science’, all saved scientific content would appear and the user would be able to share it with colleagues or professional networks. This ‘save and share’ functionality was made to accommodate the fact that Study B documented that SMEs had a need for scientific knowledge to be ‘shareable’ (Section 5.3.7.3) both within the enterprise and externally, and that the respondents from Study D had rendered a ‘Quick and easy sharing through e-mail or other portals’ a need-to-have (see Table 7.2.) Further, this module was a way to make the design **unique**, **close** and **interactive** (experience dimensions).

Because the publication module was designed to automatically draw data from VBN, this module also presented other types of scientific knowledge such as ‘research projects’, ‘research units’, ‘press clippings’ and ‘activities’ (see Chapter 6 for an analysis of the different types of content in VBN). ‘Researchers’, however, was given a separate module, which I will explain later.

The next module on the sub-page was ‘Case stories’. The idea for this module came from Study D where ‘Links to videos, press cuttings, news’ (Table 7.2) was rendered need-to-have. Providing a module with case stories was a way to concretise the use of scientific knowledge (communicative principle) and make it **close** (experience dimension) to SMEs' situation. Illustrating how other enterprises had used and benefitted from scientific knowledge was rendered relevant by the respondents in the workshop.

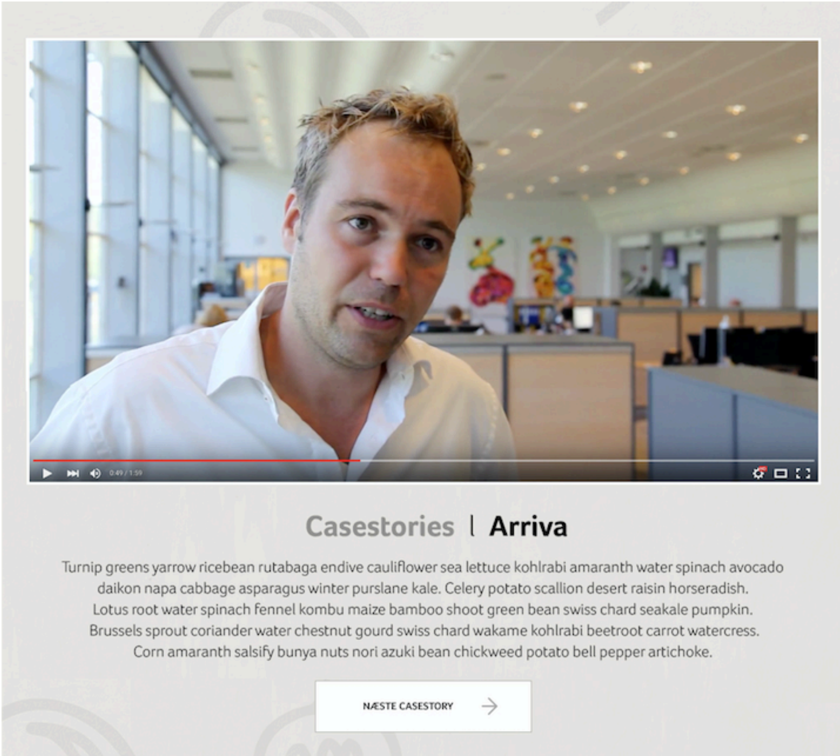

Figure 8.7. The 'Case story' module of the interface

The next module was the 'Researchers' module. Here, researchers within the specific subject were presented and their contact information appeared. When clicking on a researcher, the user would be directed to the researcher profile in VBN. The idea behind this module was to make it possible for SMEs who had found the content of the subject **relevant** and **interesting** (experience dimensions) to get in contact with someone at the university. This was a consequence of several previous findings, for example that SMEs expressed being most prone to using a relational pathway to get in contact with the university (Figure 5.11) and that a 'Contact person/support function' function was rendered need-to-have (Table 7.2). Incorporating a module where 'Researchers' were presented was thus a way to meet SMEs' criteria of a personal contact being easily accessible, including for the SMEs with no prior relations to the university. Further, it is a way of incorporating an element of a relational pathway into the otherwise generic pathway. In total, this module relates to how scientific knowledge is provided to SMEs (communicative principle).

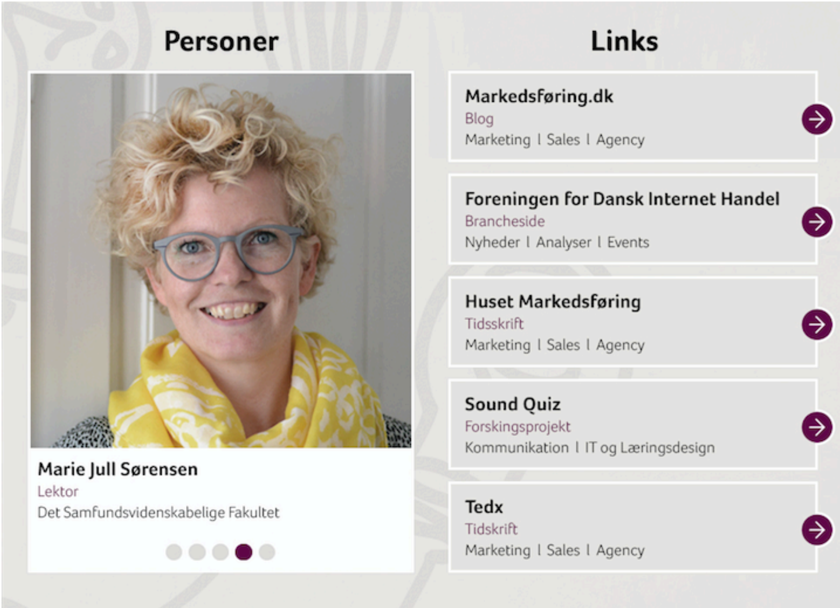

Figure 8.8. The 'Researchers' and 'Other links' modules of the interface

The last module was the 'Other links' module. Here, the idea of a 'thematic universe' including non-scientific content was materialised. This module was meant to offer quick access to other content (that is, other than scientific knowledge) on the subject that might be rendered relevant by SMEs. Furthermore, the elements of this module offered keywords on subject and trade, which could be a way to accommodate SMEs' desire for branch-specific news (Table 7.2), thus designing for **closeness** (experience dimension).

8.2.3 TITLES AND ANNOTATIONS

Constructing the titles and annotations for the interface was an important part of the development process. It is a communicative challenge that has proved very important to the dissemination of scientific knowledge more times throughout this thesis (see for example Section 4.2.5 and Section 5.3.7.2).

Previous studies of the thesis had documented several characteristics that could be related to formulations and phrasings. Meeting the preferences of SMEs on this account required a substantial reorganising of the scientific knowledge itself (communicative principle), which was challenging. For that reason, a set of guidelines for how titles and annotations should be communicated to SMEs was developed. This was done in close collaboration with my supervisor and with assistance from a student worker from the VBN Editorial Office. In these guidelines, the experience dimensions in particular were adapted.

Guideline	Explanation
A teaser in the teaser	- Begin with concrete, eye-catching and **involving** information. - Could preferably be framed as an open, involving and engaging question that invites for participation/**interaction**, i.e. 'Why should we reduce our environmental burden and how do we do it?' - Could also use opening words, i.e. 'so', 'because', 'these'.
Layman's terminology	- The vocabulary should be appropriate for a broad group of users. Understandable language (layman's terminology) rather than eclectic and speculative language, i.e. avoid words such as 'theories' and 'methods', focus on results.
Simple messages	- A sentence can only contain one idea/point/message.
Short sentences	- Make the sentence as short and precise as possible, i.e. by cutting out as many empty words as possible. - Be aware not to mention too many scientific concepts, even though the publication itself uses many. - The most important (result-oriented) information should come first.
Bullets	- Bullets can be used in order to make it easier to read.
Memorable wording	- Use memorable sentences, i.e. by using idiomatic words, clichés, provocative words or questions. - This could potentially make it **fun** to read.
Result oriented	- Focus on the results of the publication. What is new? - Enable both researcher and SMEs to **learn** something new. - If there are no new results, for example if the publication passes on well-known knowledge, then that must be made clear. - Constantly focus on why this is **interesting**.
Practical oriented	- Focus on how this can be used in practice. - Sum up the result. - This will make it **relevant** and **close**.
User oriented	- Who are we talking to? - Write 'you' or 'your enterprise'. This will make it **relevant** and **close**.

Table 8.2. Guidelines for incorporating experience dimensions into titles and annotations

The main objective of the guidelines was to keep titles and annotations **relevant** and **interesting** to SMEs (experience dimensions), which is an interpretation of how scientific knowledge could be kept practical and concrete. The intention of the guidelines was to construct some principals and instructions that could help ensure that all titles and annotations were easy to read and understand and that all sentences and messages appeared easy, quick and unambiguous. Using the guidelines as instructions for writing titles and annotations can thus be a way to make the presentation of scientific knowledge both experience-oriented and meet the preferences of SMEs. It can be a way to make possible a more **spontaneous** use of scientific knowledge, because it can help SMEs see relevance in more subjects than otherwise. Further, it is a way to make the content of the new generic pathway **unique**, **authentic** and **relevant**, all the while making scientific knowledge more accessible, relevant, understandable and usable to SMEs. In total, with this way of presenting scientific knowledge, several previous results of both Study B and Study D are accounted for as well as the 10 experience dimensions, and it can increase the communicative capability targeted at SMEs in the presentation of the scientific knowledge. Table 8.3 exemplifies how the guideline was used to reorganise the content of scientific knowledge.

Abstract, before	Abstract, after
The power of business models lies in their ability to visualize and clarify how firms' may configure their value creation processes. Among the key aspects of business model thinking are a focus on what the customer values, how this value is best delivered to the customer and how strategic partners are leveraged in this value creation, delivery and realization exercise. Central to the mainstream understanding of business models is the value proposition towards the customer and the hypothesis generated is that if the firm delivers to the customer what he/she requires, then there is a good foundation for a long-term profitable business. However, the message conveyed in this article is that while providing a good value proposition may help the firm 'get by', the really successful businesses of today are those able to reach the sweet-spot of business model scalability. This article introduces and discusses the term scalability from a company-level perspective. It illustrates how managers should be using this term for the benefit of their business by focusing on business models capable of achieving exponentially increasing returns to scale.	Scalability – How to get a truly successful business? Scalability is a term used to describe when a change in size is achievable. This paper discusses the term scalability from a company-level perspective. It illustrates how managers should be using this term for the benefit of their business. The paper concludes that businesses may 'get by' by providing good value, but that the truly successful businesses are those where the business models allow for scalability.

Table 8.3. Applying experience dimensions to titles and annotations

8.2.4 DESIGN

The design of the interface was developed by a UX designer and a graphic designer from the professional digital agency. While we shared understandings and opinions along the way, they decided the placement and size of all modules. Further, the colour scheme and illustrations were done by them. See Figure 8.2 and Figure 8.3 for an overview of their initial design.

8.2.5 DESELECTED FUNCTIONALITIES

It was not possible to include all ideas and functionalities. As Study D illustrated, several more ideas were put forward (see Table 7.2). For example, the version of the interface as presented above does not include 'Establish a profile', 'SME dating' or 'A platform for all types of collaboration'. The fact that these functionalities are not incorporated does not mean that they are not relevant. Rather, it is evidence of this being the first version of the interface and that resources did not allow for us to implement all ideas. What is implemented in this first version of the interface is what was rendered most important and most realisable within the resource frames of the project by me, my supervisor and the professional digital agency. There were functionalities we would have liked to incorporate because the results of Study D indicated them to be important, but which we had to leave out due to resources, i.e. a login page for enterprises and a search engine.

8.2.6 CHALLENGES

While we succeeded in developing an interface (generic pathway) where scientific knowledge can be presented specifically to SMEs, some fundamental challenges occurred. The main ones were challenges related to the reorganisation of scientific knowledge and challenges related to visual material.

First, as expected, transforming scientific knowledge to meet the preferences of SMEs was very challenging. The existing data in VBN did not allow for an automatic retrieval of data with these, and we thus evidently ended up having to select pieces of scientific knowledge that would manually and on a trial basis be reorganised according to the guidelines from Table 8.2. For a first version (and a prototype) this is okay, but if scientific knowledge is generally to be more accessible, relevant, understandable and usable to SMEs, this process of reorganisation has to be made easier and more automatic. To repeat what I stated in Study B (Section 5.4), accommodating SMEs' situation and providing scientific knowledge according to their needs will require the university to be willing to put time, efforts and resources into changing both the form of the scientific knowledge and the way it is communicated. The university has to decide if this is something they want to do and then put the resources into reorganising scientific knowledge to meet the preferences of SMEs. It is the same situation regarding visual material. There is no tradition for using visual material related to scientific knowledge products. It was, however, a preference of SMEs, especially and directly articulated in Study D, that scientific knowledge would be visualised through descriptive pictures. Currently, the required visual material does not exist, hence why we had to manually find pictures for all modules. This was very time-demanding and the result was often far from optimal. Again, if the university prioritises meeting the criteria of SMEs, the traditions for producing and reporting scientific knowledge should be changed into including other types of material, i.e. proper visual material. This discussion on what it will require of both university management and individual researchers, and of both producing and reporting scientific knowledge, will be taken up in Chapter 13 as one of the final reflections of the thesis.

8.2.7 REFLECTING ON THE INCORPORATION OF EXPERIENCE DIMENSIONS

A brief reflection on the incorporation of experience dimensions is in order. While there are several reasons to use experience dimensions in this context (as discussed in Section 8.1), one could also argue that the experience dimensions could 'interrupt' SMEs in an inconvenient way. This perspective opens a discussion on whether or not diverting a user from his or her pre-planned goals is desirable. While it could be a means to attract attention, it could also work in the opposite way. Study B identified that SMEs conducted two types of searches: The 'purposeful search' and the 'inspirational search' (Section 5.3.3). It was indicated that SMEs often opted out of an inspirational search due to a lack of time and resources. Further, Study B showed that SMEs could not be expected to search (browse) aimlessly about for something, because they needed the process to be as efficient as possible (Section 5.3.4). These results could be interpreted as speaking against incorporating experience dimensions that invite for **spontaneous** searching behaviour. But at the same time, SMEs did themselves mention the inspirational search and stated that they would like to do it more, if their situation allowed for it. Incorporating experience dimensions into the generic pathway could then also be seen as an effort that explores how this inspirational search is made more likely for SMEs to prioritise.

No matter what perspective you have on this matter, incorporating experience dimensions into the generic pathway is in line with the explorative aim of the thesis, seeing as it is not something that – to my knowledge – has been done before in this context. The generic pathway developed and presented in this chapter therefore contributes to a discussion on how existing scientific knowledge can actually be disseminated to SMEs and whether or not the experience dimensions help optimise the dissemination of scientific knowledge to SMEs. This discussion is not finished with this study, and while the Evaluation Study in Chapter 11 will relate to it, I also recommend it as a focus point for future studies, which will be brought up again in Chapter 13.

8.3 THE NEXT STEP

The interface as presented in this chapter makes up the first prototype. As stated in Chapter 3, the goal is to use this concrete example of a generic pathway to explore whether it is a profitable way to disseminate scientific knowledge to SMEs. That means if it helps make scientific knowledge more accessible, understandable, relevant, and useable to SMEs. That will be the focus of the Evaluation Study, but before I get to that, another iteration of development will be conducted in order to include SMEs' perspectives on the current interface and make adjustments to the design and functionalities.

CHAPTER 9: USABILITY STUDY

To test the user's attitude towards the first version of the digital interface, a Usability Study consisting of seven usability tests was conducted. The purpose of the Usability Study thus was to further contemplate the fifth sub-question (SQ5): How can a generic pathway disseminate scientific knowledge based on an understanding of the situation and preferences of SMEs? As mentioned in Section 3.3.5, *usability* means to match products and systems closely to the needs and preferences of the users and to make products and systems easier to use. When conducting usability tests, the primary goal is "to determine whether an interface is usable by the intended user population to carry out the tasks for which it was designed" (Preece et al., 2015, p. 457).

As was the case in the Workshop Study, the tests of this study were planned and facilitated by the UX designer from the professional digital agency. While I participated mainly as an observer, the planning and the processing of the results of this study were primarily in the hands of the UX designer. Accordingly, the purpose of this chapter is to describe this iteration and make clear how the usability tests were carried out and how they influenced the development of the generic pathway. Therefore, this chapter will consist of short descriptions of the (1) purpose, (2) procedure and (3) results of the Usability Study. As mentioned in Chapter 8, we had chosen one topic and filled the content out manually in the interface. This was the topic used for the usability tests.

9.1 PURPOSE OF THE USABILITY STUDY

As mentioned in Section 3.3.5, the Usability Study was designed to test both the use-ability of the interface (SMEs' actual use of it) and the user experience on the interface (SMEs' experience when using it). By that, the goal was to test the design, the concept and the use of the interface. The UX designer had made a plan to test the interface on different parameters, including:

- Content: Is the text and content understandable?
- Design and colours: Are the visual elements in accordance with the preferences of SMEs? Is it up to date according to trends and tendencies?
- Functionalities and layout: Are the functionalities and the structure of the interface understandable and usable in accordance with the purpose of the interface?
- Concept: Does the overall concept make sense according to SMEs?

Further, the UX designer had the following protocol for the usability tests:

1. Do the users read the content before they interact? Do they understand the concept?
    a. Do they understand the name of the interface?
    b. Do they understand the purpose of the interface?
    c. Do they remember things from the previous page?
2. Do the users understand their journey through the interface?
    a. Functionality: Like/dislike
    b. Functionality: Share
    c. Functionality: Back to the Topics
3. Can the users find the interaction zones and find out how to use them? (clarity)
    a. Functionality: Like/dislike
    b. Functionality: Share
    c. Functionality: Back to the Topics
    d. Related content
4. Is there too much content on the individual pages?
    a. Related content
    b. Do they actually scroll to the bottom?

This protocol dictated the procedure of the usability tests. Accordingly, the UX designer defined some success criteria and assignments, which made it possible for him to analyse and answer the questions of the protocol.

9.2 PROCEDURE OF THE USABILITY TESTS

The usability tests all strictly followed the same procedure, which is outlined in the following. As mentioned in Section 3.3.5, the usability tests were structured as a 'Thinking Aloud Test' (Nielsen, n.d.) and were recorded via the iPad that was used to conduct the studies. It recorded both actions and sounds of the entire process. Note that the respondents were given these question on a piece of paper in order to read through them themselves, although the UX designer also talked them through it.

Introduction

1. What is your name and your age?
2. How much time do you spend on average on the internet during the day, including both work and privately?

Front page

3. What is the first thing you notice and what is your first impression of the interface?

4. What do you think the interface is about and what do you expect to get out of using it?
5. Try and find the topic ‘Sustainability and CSR’ and click on it.

Sub-page

6. What are the first things you notice?
7. Compared to your expectations for the interface that you mentioned before (Q3), does the content live up to your expectations? What does and what does not?
8. What functionalities do you notice?
9. Spend the next few minutes exploring the interface and its functionalities and move on to the next question when you are ready.

Content and functionalities

10. Can you remember what the last article was about?
11. Where would you click in order to share the article?
12. Where would you click in order to find more information about the article?
13. Where would you click in order to go back to the front page?

Final questions

14. If you were to suggest one improvement for the interface, what would it be?
15. On a scale from 1-10 how transparent was the interface related to its content and how usable was it in your opinion?

9.3 RESULTS OF THE USABILITY TESTS

As was the case with the Workshop Study in Chapter 7, the data produced in this study is not as systematically documented as I could have hoped. While the UX designer analysed the recordings from the iPad, I did not get access to this material. Furthermore, the improvements that the usability studies induced on the interface was carried out by the UX designer. While we shared notes immediately after the studies and discussed what had to be developed further, the actual development (and thereby the final interpretation of the results of this study) was carried out by the UX designer. Therefore, the following summary of results of the study is based on my own and the UX designer’s notes and on our discussion of improvements.

9.3.1 CONTENT

The respondents mentioned that the introductory text on the front page did not describe the purpose of the interface clearly enough. They pointed out that this text could be even more focussed on what the users would get out of the interface. It was suggested to write something about how SMEs in general could benefit from using scientific knowledge. Further, they mentioned that the sub-title on the front page was not big enough. Because of this they found it harder to decode the purpose of the interface.

Generally speaking, the respondents expressed a need for something to immediately leap out at them in order for their interest to be caught. Accordingly, the topics on the front page has to be diverse enough for everyone to find something interesting. On a related note, they pointed out that pictures are generally really important for their assessment of relevance and purpose. This is related to both the topics on the front page and to the article module on the sub-pages. Regarding the text that describes the individual articles, some mentioned that they would prefer even more focus on results.

9.3.2 FUNCTIONALITIES

The respondents generally expressed that the use of the article module on the sub-pages was not intuitive. The article module posed different problems to them. First, several of the respondents did not understand what it was or how it should be used. A couple of them did not even notice that the content was articles. Second, the swiping functionality of the module turned out to be difficult to understand and use for the respondents who were not accustomed to using Tinder or similar apps. Third, the respondents generally did not understand the labels/buttons of this module. Related to the swiping function, they did not like the annotation ‘Like and Save’ because it made them think that their actions would be visible on social media. It was suggested to change the concept into ‘Next article’ and ‘Previous article’, thereby also offering a second navigational option for the ones who do not immediately understand the swipe functionality. The annotation ‘Share’ had the same effect, and the respondents expressed that they would prefer it to be called ‘Send to e-mail’. Fourth, clicking on the articles was also not intuitive for the respondents. They mentioned needing a button called ‘Read more’ to make this option clear. Fifth, the ‘Share articles’ functionality was rendered irrelevant by more respondents. They could not imagine needing to share an entire list of saved articles. It was suggested to make it possible to share selected articles instead. Specifically, a ‘shopping bag’ functionality was suggested. In conclusion, the article module and all its annotations/buttons generally needed better explanations.

It turned out that a search functionality was frequently requested, although this was rendered less important in the Workshop Study. Generally speaking, the usability tests indicated that there was less enthusiasm about the ‘inspirational’ idea than Study B and Study D had indicated. The respondents in the Usability Study expressed that they would mainly use this interface if they were looking for something specific. This spoke in favour of a search function and against the swipe function, which the article module is built around and which was one of the primary ideas from the Workshop Study. The respondents of the Usability Study articulated that they would particularly like to be able to search using keywords. On a related note, the fact that the article module showed one scientific article out of a large number of articles appeared frustrating to the respondents. There seemed to be consensus that a maximum of 10 articles should appear, with the possibility to load more. The respondents also articulated that they would need more filtering options if they were to use this module. In total, the UX designer and I were left with the conclusion that this module as a minimum had to have keywords attached and optimally also offer more filtration options. The respondents expressed that they did not want to read through a lot of articles without a goal in mind and without any guarantees that they would find something relevant. Although this stands opposed to the results of the Workshop Study, it actually clearly echoes the findings of Study B. In Section 5.3.4, it was pointed out that SMEs cannot be expected to sit down and browse aimlessly about because it is neither efficient nor guaranteed to result in something usable. So, related to the need for concrete searching versus the desire for inspirational searching, the empirical data points in two different directions. While Study B pointed to both of these preferences, Study D pointed only to the inspirational search and now Study E emphasises the need for concrete searching. While the interface will be further developed based on the results of the usability tests, this will not include a complete redesign of the article module. Accordingly, the article module will be adjusted, but it will still be based on the swiping idea. Of course, there is no right answer for all included participants. The data points out differences of opinion, and while some SMEs or employees will prefer one thing, others will prefer the other. However, I will use the Evaluation Study (Chapter 11) to get an idea about a larger number of SMEs' and individual employees' attitude towards this matter.

The respondents also had trouble finding out how to get from the sub-pages back to the front page. It had to be clearer. Generally speaking, the usability of the sub-page was not optimal. It lacked transparency.

Finally, more respondents mentioned that they would like to be able to save the articles they had found in order to get back to them another day. This pointed out the need for a login page, which was also discussed during the Workshop Study but was rendered less important.

9.3.3 DESIGN

The respondents generally perceived the design and the colours positively. The general opinion was that it looked modern and nice.

9.4 THE NEXT STEP

In the next chapter, the 'final' interface will be presented. I highlight the word final in order to stress that this version of the interface is still a prototype where further development is needed. For example, a big issue for which to find a solution is how to generate content for the interface, which was addressed in Chapter 8. As mentioned in Section 8.2.1, we decided to only incorporate subjects that could be deemed relevant across trades, i.e. business development, management or marketing, and we then manually generated this content for the prototype. If the interface is to be launched and its full potential should be realised, trade-specific subjects must also be provided. Further, manually generating content for the interface is not a sustainable solution in the long run. In total, if scientific knowledge should truly become accessible, relevant, understandable and usable to SMEs, efforts have to be made to change the form and organisation of scientific knowledge. For these reasons, the 'final' interface, as it is presented in this thesis, is still only a prototype.

CHAPTER 10: PRESENTATION OF THE GENERIC PATHWAY

In this chapter, the 'final' prototype of the interface will be presented. Several changes regarding both functionalities and design were implemented after the Usability Study, and these will be made clear and motivated continually in the following presentation. As already mentioned, this version of the interface is the last version that will be part of this thesis and it is also this version that will be used for the Evaluation Study in the next chapter. Please note that all pictures in the interface were changed before this iteration due to copyright issues.

A test version of the interface can be accessed via http://test.virksomviden.klean.dk.

10.1 MODULES IN THE INTERFACE

The first module on the front page of the interface is the 'Presentation' module. It consists of a picture, a logo from Aalborg University, the title of the interface and an introductory text that explains the purpose of the interface.

Figure 10.1. The 'Presentation' module of the interface

Since the first version (see Figure 8.2), the subtitle, which is an explanation of the title, had been made bigger and the introductory text has been altered. Both changes were brought on by the usability tests, which witnessed that more test users did not notice the sub-title and that they needed the introductory text to focus more on what the university has to offer enterprises (Section 9.3.1).

The next module on the front page of the interface is the 'Subject boxes' module. It consists of six subject boxes and a button that allows the user to load more subjects. No changes were made to this module.

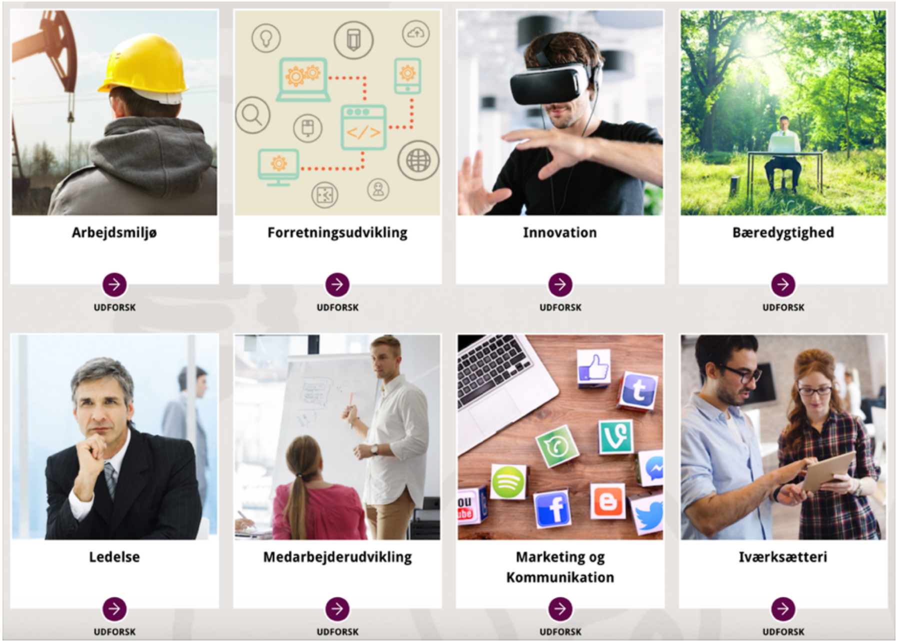

Figure 10.2. The 'Subject boxes' module of the interface

Large alterations were made on the sub-pages. The first module, which is the 'Publications' module, was significantly altered after the usability tests. As described in Section 9.3.2, the use of this module was not intuitive, and content, functionalities and buttons were misunderstood.

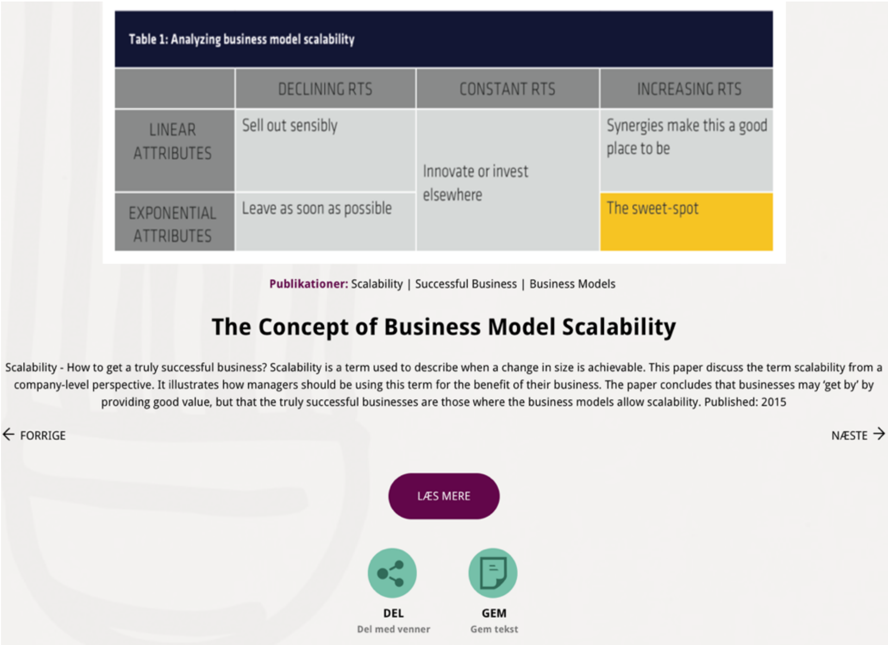

Figure 10.3. The 'Publications' module of the interface, version 2

The picture, keywords, title and text are the same as in the previous version of this module (see Figure 8.3). However, after the redesign, the functionality of this module was changed so that the swipe functionality was removed and instead buttons with 'previous' and 'next' were added for the users to browse through the content. Further, the buttons 'like and save' and 'skip' were changed into 'Share' and 'Save' to make the intention and functionality clearer. If a user presses 'Share', a box with options for sending an e-mail will appear. If a user presses 'Save', the content is saved in the 'Shopping basket' at the top of the page. The 'My science' module (see Figure 8.6) was completely removed.

The next modules of the sub-pages are the 'Video' module and the 'Researcher' module. The 'Video' module figured as a 'Case stories' module in Figure 8.3 and Figure 8.7. It was, however, changed before the Usability Study out of consideration to available material. The last module of the sub-pages is the 'Other links' module. No significant changes were made to any of these modules after the usability tests.

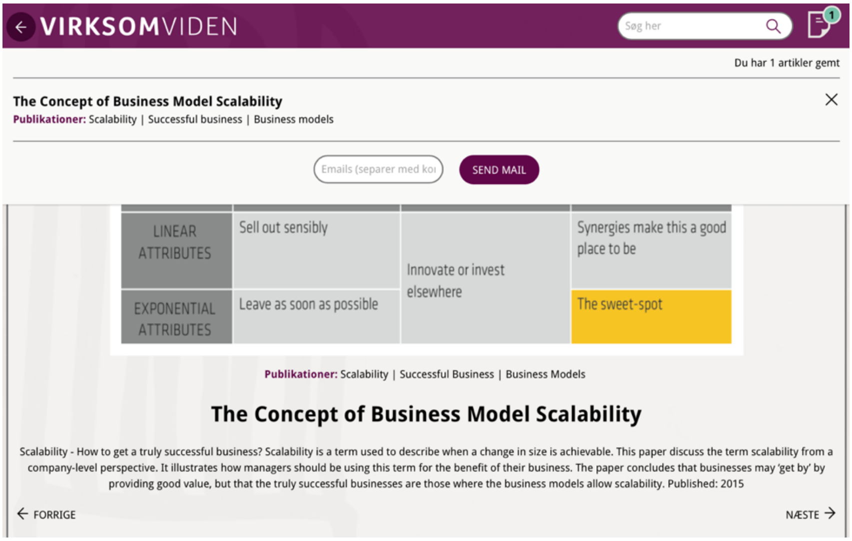

Figure 10.4. The 'Shopping basket' functionality of the interface

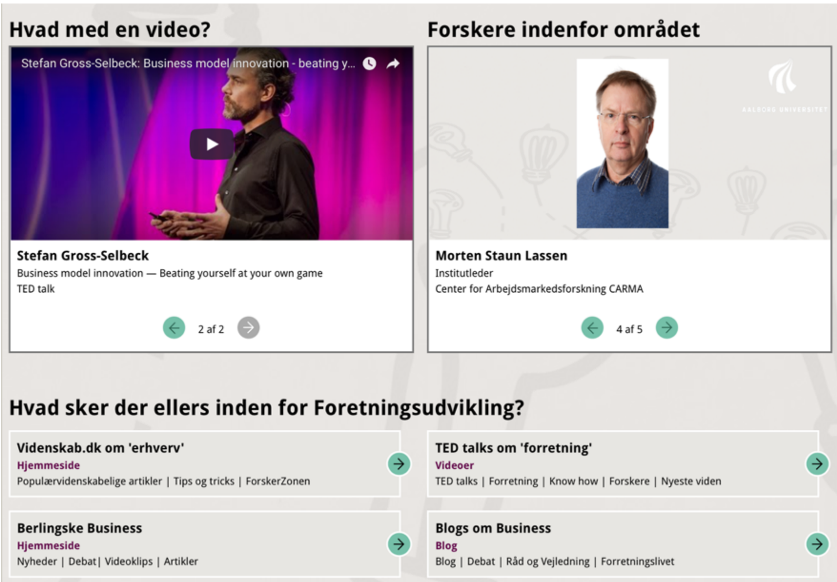

Figure 10.5. The 'Video' module, the 'Researchers' module and the 'Other links' module of the interface

10.2 REMARKS REGARDING THE INTERFACE

As the figures in this chapter illustrate, although I have not explicated it throughout this presentation, the guidelines for incorporating experience dimensions (Table 8.2) are still worked into all titles and annotations of the interface.

All in all, the interface probably became a lot simpler to use after the usability tests, which might be a good thing. It will, however, be up to the Evaluation Study to explore what SMEs think of this way of presenting and disseminating scientific knowledge.

10.3 TYPE OF COMMUNICATION PROVIDED IN THE INTERFACE

In Chapter 2, knowledge dissemination was defined as a type of communication. To briefly recapture, it means that a dissemination process features the three basic constituent elements of communication: a sender (the university), a message (scientific knowledge and the dissemination thereof) and a receiver (the SMEs) and is done through a medium/channel (the interface). The goal of a dissemination process is to reach understanding and to make knowledge common. As discussed in Section 2.2.1, the distinction between the two classical paradigms – the transmission and the interaction paradigm – illustrated different perspectives on the discipline of communication. This profiling of knowledge dissemination as a type of communication brings on a need for reflecting on the type of communication that is provided in the interface presented above, and what objectives it entails.

I stated in Section 2.2.2 that the interaction paradigm and the understanding of communication as a circular and interactive process is the most modern understanding of communication, seeing as knowledge cannot simply be taken out of one person and put into another. While I believe this to be accurate, and while the development of the interface builds on an interactive communication process where different empirical studies have provided insights to the specific, situated meanings and meaning-making practices of SMEs (see Section 3.2), the type of communication offered in this interface is not extremely interactive or dialogical. In the interface, scientific knowledge is presented and provided according to new principles, but the interface does not allow SMEs to participate in the creation of the message (the scientific knowledge). In other words, the methods used to develop the interface have aspired to make it a co-owned interface, which was mentioned in the Literature Study as a possible solution to more of the barriers identified (see Section 4.2.3). However, seeing as the interface (the channel) is a generic pathway, and because it does disseminate existing scientific knowledge in the form of Pure data, the communication provided *in* the interface can be characterised as somewhat transmitted rather than interactive. It is a consequence of the type of knowledge that is disseminated here. A generic pathway just is not the same as a relational pathway. The type of communication is different, which is a consequence of the predefined conditions of the PhD project. Within the frames given, I have sought to optimise the dissemination/communication, and I have given special attention to the (re)organising of scientific knowledge. And as Study D and E have shown, SMEs are actually content with using generic pathways. The interface provides SMEs with scientific knowledge according to their own preferences, and it concretises the principles that are important for SMEs to deem this type of knowledge relevant. It could, however, be interesting to further explore how the communication offered *in* such a pathway could be made more interactive, which I will reflect on in Chapter 13.

CHAPTER 11: EVALUATION STUDY

In this chapter, the attitudes from potential users towards the prototype of the generic pathway that was developed and presented in the previous chapters will be evaluated. As mentioned in Section 3.3.6, the purpose of the Evaluation Study is to perform a summative evaluation on SMEs' short-term attitudes towards the generic pathway and its different functionalities, which means that it will examine to what extent the generic pathway, which is based on an understanding of the situation and preferences of SMEs, optimises the dissemination of scientific knowledge to SMEs (SQ6).

As mentioned in Section 3.3.6.2, the sample for this study consisted of 24 SMEs with a total population of 844 employees, 395 of whom received the survey (see Figure 3.4). Out of these 395, I received 121 responses. It adds up to a 30,63 percent response rate. As argued in Section 3.3.6.2, this seems acceptable compared to other studies that have conducted surveys amongst SMEs (see for example Bruneel et al., 2010; de Zubielqui et al., 2015; Muscio & Vallanti, 2014; Sher et al., 2011; Sherwood & Covin, 2008). Out of the 121 responses, 45 respondents dropped out during the survey, which leaves a drop-out rate of 37,2 percent. Because several respondents chose to not finish the survey, each of the figures throughout this chapter will contain information about how many respondents (n) it is based on.

I will begin the chapter by presenting the results of the survey. First, a few demographics of the respondents and the SMEs they represent will be described. Second, the third key theme about attitudes towards the generic pathway (see Table 3.5) will serve as the point of departure for the descriptions and discussions of the chapter. When the data allows for it, the quantitative data representations will be supplemented with exemplifying quotes from the open questions of the survey. Third, summarising and discussing the results will enable an answer to SQ6, thus contributing with relevant insights for the answer of the thesis' research question. However, because the survey for this study was kept short, not all aspects can be evaluated. For that reason, the chapter will end with a methodological discussion on limitations and biases.

11.1 DEMOGRAPHICS

To illustrate the variety in the SMEs that are represented by the respondents, a few relevant demographics will be presented. As described in Section 3.3.6.2, the sampling strategy for the study was based on a maximum variety principle. The goal was to explore the attitudes of a larger number and varied group of

SMEs compared to previous studies of the thesis. Figure 11.1 illustrates the geographical location of the respondents' SMEs.

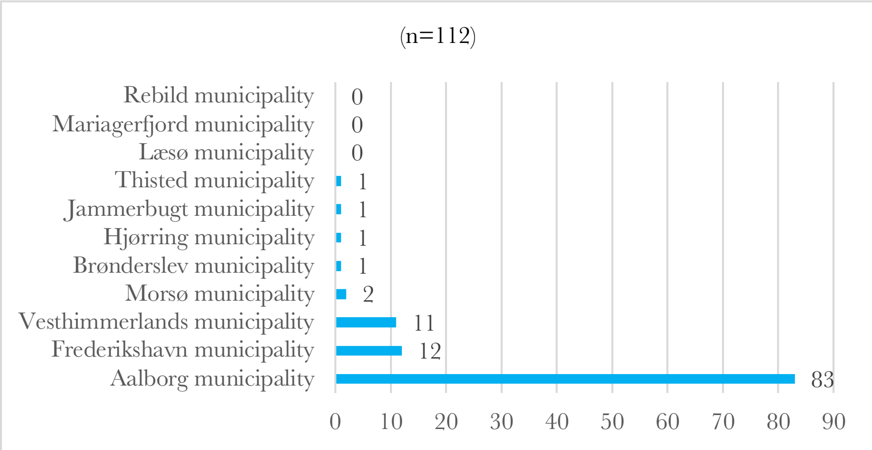

Figure 11.1. Survey results: Geographical location of the SMEs

As the figure shows, I did succeed in having a spectre of municipalities represented in the survey. However, Aalborg municipality is over-represented in the sample: 74,1 percent of the respondents work in an SME located in Aalborg municipality. This over-representation was expected due to the sampling strategy (Figure 3.3), where half of the chosen SMEs were from Aalborg municipality compared to the other half being from any one of the remaining 10 municipalities. While the over-representation is acceptable due to the sampling strategy and because Aalborg municipality is by far the largest of all the municipalities in Northern Jutland and accordingly houses more enterprises, it could affect the results. It means that the amount of enterprises with local ties to the university is by far the largest. As addressed earlier in the thesis, this could mean that they are more used to the university and have greater advantages in improving the quality of their knowledge resources (Barbosa & Romero, 2012; Fukugawa, 2013).

Figure 11.2 illustrates the sectors of the respondents' SMEs. While there is a variety in sectors, a bias occurred. Several respondents have chosen 'Other', although their SME could arguably fit into one of the closed categories. For example, several respondents filled in the optional text box and wrote that they work in IT, which could fit into several of the categories. By that, the picture in Figure 11.2 might not be completely accurate nor show the actual variety in response. It indicates that enterprises need the sectors to be even more specific. A full list of elaborations for the 'Others' category appears in Appendix 5.3 (Section 1.3).

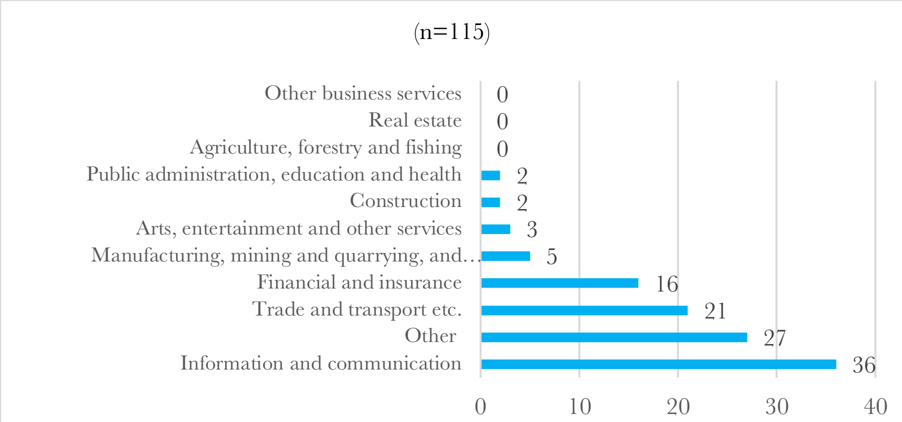

Figure 11.2. Survey results: Sector of the SMEs

The survey also included questions about the respondents' previous relations to the university (Figure 11.3) and current use of the university (Figure 11.4). These questions were relevant to include in order to understand if the respondents were accustomed to interacting with the university and to using scientific knowledge in relation to their work.

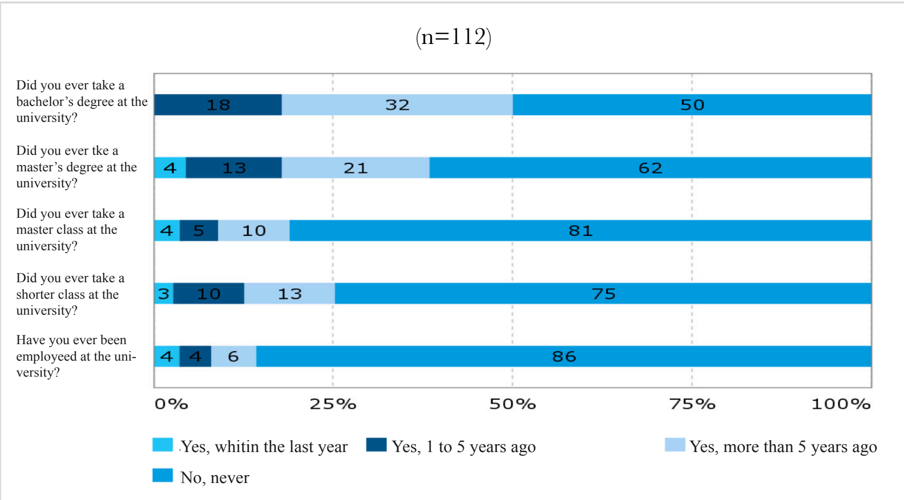

Figure 11.3. Survey results: Previous relation to the university

As Figure 11.3 illustrates, the majority of the respondents had no previous relationship with the university. At least 50 percent answered 'No, never' to all the questions in this figure. It indicates that the larger part of the respondents was not accustomed to university traditions or approaches. Furthermore, Figure 11.4 shows that the larger part of respondents 'never' use the university or scientific knowledge in relation to their current work. What appears to be most used is 'reading scientific publications' and 'collaborating with students', which 53 percent and 55 percent respectively state that they sometimes do. However, while a large part of the respondents says they 'never' use the university in any of the optional ways, there is still a significant number of respondents that say they do use these options in relation to their work. These results can be interpreted as the respondents being largely unaccustomed to using the university but not uninterested in doing so.

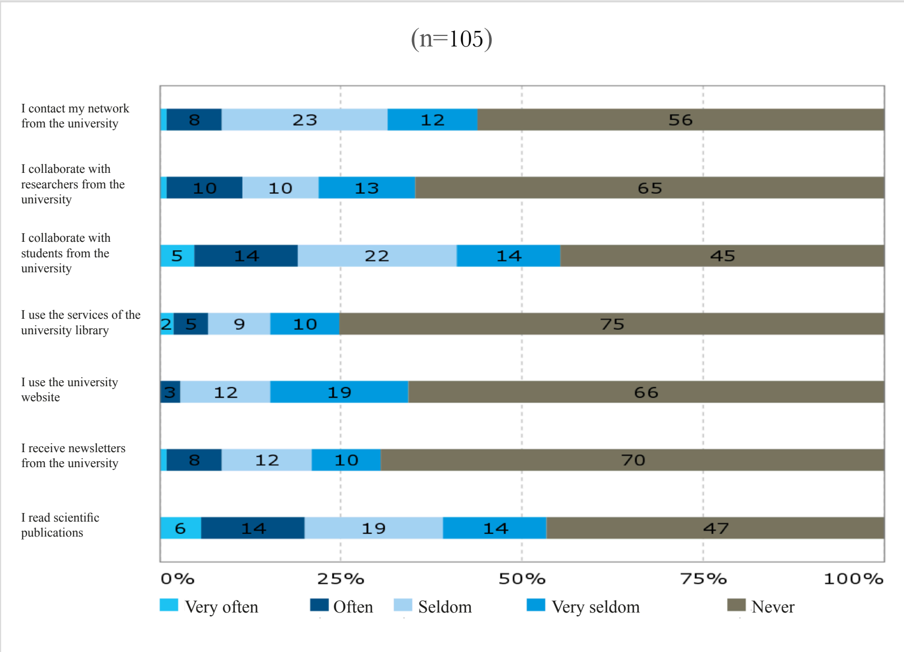

Figure 11.4. Survey results: Current use of the university in connection to work-related assignments

11.2 ATTITUDES TOWARDS THE GENERIC PATHWAY

The survey asked if the respondents could imagine using the generic pathway in relation to their work. Figure 11.5 visualises the responses.

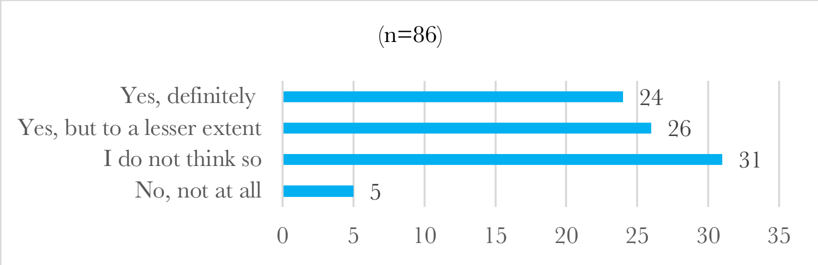

Figure 11.5. Survey results: Could you imagine using the new generic pathway in relation to your work?

As Figure 11.5 shows, 58 percent of the respondents chose one of the two positive options, whereas 42 percent chose one of the two negative options. By that, the positive answers slightly outweigh the negative ones, although the most frequently given answer was 'No, I do not think so'. What is more interesting, however, is that only five respondents (5,8 percent) categorically answered 'No, not at all', while 24 respondents (27,9 percent) categorically answered 'Yes, definitely'. It indicates that a potential use of the generic pathway is in fact imaginable. The respondents had the option to elaborate on these closed answers in an open text box. Nineteen of them did so (see Appendix 5.3, Section 3.1). Here are a few examples of the positive articulations.

Quote 1	Relevant and useful knowledge that is presented in an easy and accessible way.
Quote 2	It is a concrete platform where knowledge is easy to access. The site seems very manageable and especially the first page with a subject presentation catches my interest and I want to look more into it and find out what articles the different subjects have. Research-based knowledge is very interesting – here it is made easy to access and formulated in a concrete and understandable way that is usable in a practicable workday in a private company.
Quote 3	It appears to be a good entrance where you are directed to what you are looking for no matter if it is 'technical engineer knowledge' or management, business models or other.

Of the positive expressions, the respondents used words such as: Concrete, easy, manageable, good entrance, relevant, usable, accessible, informative and educative. These words indicate what SMEs found attractive in the generic pathway. To demonstrate the negative expressions, here are a few exemplifying quotes:

Quote 4	It has to be easier to find something relevant.
Quote 5	The website does not seem to contain the subjects that are most relevant to the company I work in. Further, it is based on pull-knowledge (that is knowledge you have to drag out yourself) and I do not really have time to sit and look for that. In my eyes, it would be more usable if it also had push-knowledge, that is knowledge that is pushed at me. I also do not think it is an answer to the dissemination challenge the academic world is facing in relation to practice. Or in other words: because scientific papers are presented in another way and in another forum, does not make it easier to read and translate into practice. But if it is really the case or not is hard to say based on a short video.
Quote 6	I doubt that I will find anything relevant that way.

The positive elaborations actually use words that quite clearly echo several of the intentions behind the design of the generic pathway (see for example Section 8.1 and Section 8.1.2). The elaborations on the negative perspectives, on the other hand, centre around the problem of relevance: That is, whether the generic pathway provides relevant content or offers functionalities that allow SMEs to find something relevant. This should be seen in the light of the subjects that are provided in the prototype. As mentioned in Section 8.2.1, for the prototype we decided to only incorporate subjects regarding the overall business conduct that could be deemed relevant across trades, i.e. business development, management or marketing. The respondents of the survey do not know that this content is only at prototype level, which is why this fact could lead them to think that the scientific knowledge presented in this interface is not trade-specific enough. As mentioned in Section 9.4, in order for the prototype to be launched and realise its full potential, trade-specific subjects also have to be provided. However, the problem of relevance as presented by these quotes does reintroduce the two-sided reason SMEs had to look for new knowledge, which was first addressed in Study B (see Section 5.3.3). The study showed that SMEs mainly searched for new knowledge (1) when needing precise information in order to solve a pressing problem or task or (2) when looking for inspiration in order to update their knowledge by looking for new ideas, technologies, processes and products. While Study D pointed to SMEs being enthusiastic about the 'inspirational search', for example by rendering a Tinder-function 'need-to-have' (see Table 7.2), Study E indicated that they were actually more reluctant about this idea (see Section 9.3.2). However, the generic pathway did end up prioritising the inspirational search in favour of the purposeful search. Although the swiping functionality was altered as a result of the Usability Study, the main idea was still to look through subjects and browse through content to find something relevant as opposed to searching specifically for it. As these quotes from the Evaluation Study now indicate, this might be problematic. SMEs might need a better balance between searching for precise information and searching for inspiration, which is also in accordance with the results of Study B. Further, Quote 5 mentions that it takes more than a new channel and a new presentation style to make scientific knowledge usable to SMEs. That might very well be the case, which I will get back to later in this chapter. While these quotes provide more in-depth insights into the thoughts of the respondents, it is relevant to find out more about the answers from Figure 11.5. While this question was the first question to the key theme on attitudes towards the interface (see Table 3.5 and Appendix 5.3), the following questions had the respondents reflect further on their attitudes towards the different parts and functionalities of the generic pathway.

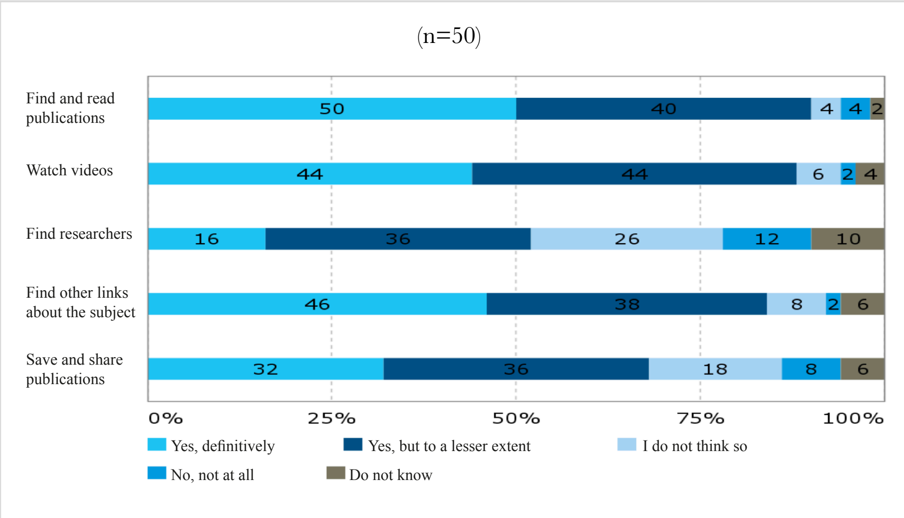

Figure 11.6. Survey results: What functionalities could you imagine using?

For the results in Figure 11.6, it is consistent that more than 50 percent of the respondents answer that they would 'definitively' or 'to a lesser extent' use all of the functionalities in the generic pathway. Please note that this question was only posed to the respondents answering positively to the question from Figure 11.5. Once again, the number of respondents answering categorically 'yes' is significantly higher than the number of respondents answering categorically 'no'. It indicates that none of the functionalities are completely misplaced and that, quite the reverse, all of them are valid to incorporate. Out of the functionalities, the 'Find researchers' gets the least positive response. When exploring what channels SMEs would use to contact the university (see Figure 5.11), Study B showed that SMEs were very likely to contact someone they already knew or to search for a personal contact (relational pathway) to call or e-mail. On the other hand, the results of the Workshop Study clearly showed that SMEs preferred subjects over persons (see for example Table 7.1 and Section 7.2.3). Now, this result of the Evaluation Study indicates that the 'Find researchers' functionality, which is a way of incorporating aspects of a relational pathway into the generic pathway, might be less relevant than Study B indicated. However, because the data of this study does not allow me to explain the answers, a qualitative follow-up study would be relevant before determining this. It might be that the users simply could not relate to the use of this functionality in the short presentation video, and that they would find it more relevant when they sit down and use the interface. However, such a follow-up study falls outside this thesis and can be an idea for a potential next iteration as part of future research.

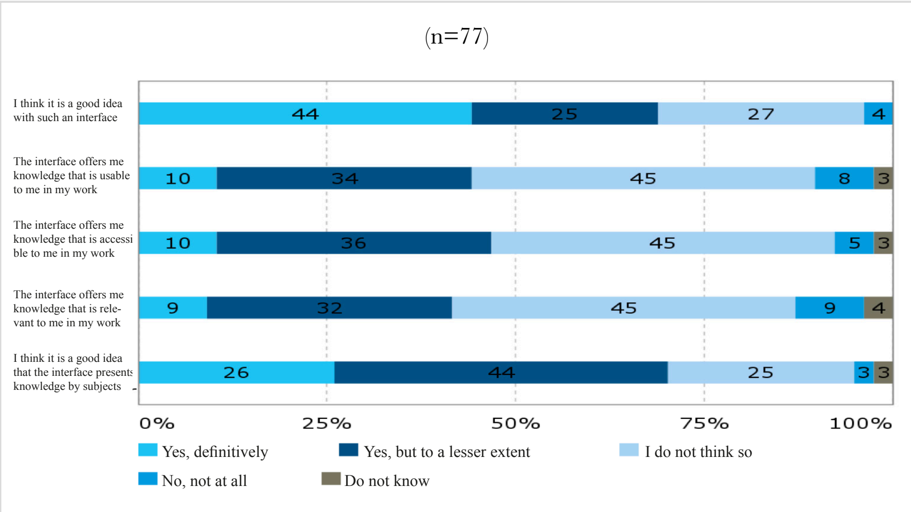

Figure 11.7. Survey results: Statements about the generic pathway

The results in Figure 11.7 show that 69 percent of the respondents think that this interface is a good idea, and that 70 percent think it is a good idea to present knowledge by subjects. While neither of these results are unambiguous, they do indicate that the larger part of the respondents has a positive attitude towards the basic concept of the generic pathway. Whether the respondents think that the interface offers knowledge that is usable, accessible and relevant is worthwhile looking into. Once again, no definite pattern can be drawn, but a consistent tendency is that a large part of the respondents 'do not think so' (45 percent). However, 'yes, but to a lesser extent' is also answered frequently. In total, these results indicate that SMEs are ambiguous about their attitudes in this respect. It can be interpreted as the generic pathway being 'all right' but not 'very good'. A result that supports this interpretation is that when asked how usable they found the generic pathway to be on a scale from 1-10 (1 being not at all usable and 10 being very usable), the average score was 6,0 (n=78). While it can be a consequence of the way scientific knowledge is presented in the interface, it can also be a consequence of a lack in the presentation of the interface in the survey, which I will get back to later. Finally, I will once again point out that the subjects presented in the prototype were very limited and only contained subjects with relevance to SMEs as they are broadly perceived. This might influence SMEs that are very focussed on activities related to their core business, to find the content irrelevant.

A final question of the survey introduced a more formative focus of the evaluation and asked the respondents whether they thought any functionalities were missing from the generic pathway. This question was optional and could be answered in an open text box. Here, 17 respondents contributed with their perspectives. Here are some of the comments/suggestions (see all answers in Appendix 5.3, Section 3.4):

Quote 7	In my eyes, one of the big challenges regarding research-based publications is to understand them and implement them in a regular everyday practice. I do not immediately think that the platform solves that problem. Could you maybe imagine that there would be versions of the publications that were targeted practice – that means that they can be read and understood by regular mortals?
Quote 8	Sharing at social media
Quote 9	Most companies today are so busy that they rarely have time to study scientific publications that offer a good but 'general' knowledge about a subject… a company often has concrete problems they want solutions for. Therefore, I think it would require a university employee that takes the time to get acquainted with the problem that a company wants solved. This employee could then guide the company in a specific direction. It would make it all more concrete and therefore motivate the companies to acquire new knowledge.
Quote 10	I miss a functionality where you can subscribe to knowledge within certain subjects, that is a push-functionality. Furthermore, there could be a sign-up service, where you could request new themes or ask for certain angles on existing themes.
Quote 11	I somewhat miss an overview of the different publications. The theme-division works really well and when you click on a theme it could be really great with an overview of the content. Maybe just as a list with headlines. This is in order to navigate quickly to the relevant publication and be sure

	to not spend unnecessary time reading i.e. publication number 2, if it turns out that publication number 5 was more relevant.
Quote 12	It is important that there is a good search functionality with filters, even if you are supposed to be led where you want to go more or less automatically.
Quote 13	Could a newsletter be relevant? Something like DBA's advertisement agent where you get an e-mail every time something new happens, there are arrangements within your subject or the like.

As these quotes show, the respondents had different ideas for how the generic pathway could be optimised. All these ideas have been brought up by respondents in earlier studies in the thesis as well, see for example Table 7.2. Now, however, the suggestions are more concrete because the respondents in the Evaluation Study have actually seen the design and functionalities of the generic pathway. The quotes are thus indicative of what could be prioritised to implement in a potential future iteration.

11.3 SUMMARISING THE FINDINGS

The Evaluation Study has provided some indications about SMEs' (short-term) attitudes towards the generic pathway and its functionalities. First, the study showed that 69 percent of the respondents think that this interface is a good idea, and that 70 percent think it is a good idea to present knowledge by subjects (Figure 11.7). These results indicate that, at large, there is a positive attitude towards the basic concept of the generic pathway. Further, 58 percent of the respondents stated that they could imagine using the generic pathway for work-related problems (Figure 11.5), which indicates that a potential use of the generic pathway is in fact realistic. The respondents used words such as 'concrete, easy, manageable, good entrance, relevant, usable, accessible, informative and educative' to describe what they found attractive about the generic pathway. Only 5,8 percent categorically stated that they would not use the generic pathway. The respondents mentioned the problem of 'relevance' as something that could prevent them from using the generic pathway. The problem of relevance related to whether the generic pathway (1) provided relevant content and (2) offered functionalities that made it possible to find something relevant. As mentioned above, the limited content and subjects presented in the prototype could have influenced these results.

When asked how usable the generic pathway appeared to be on a scale from 1-10 (1 being not at all usable and 10 being very usable), the average score was

6,0. It indicated that the general attitude of SMEs was that the generic pathway was 'all right' but not 'very good'. Similarly, 45 percent of respondents did not immediately think that the generic pathway offered knowledge that was usable, accessible or relevant in their work (Figure 11.7). Once again, the type of subjects presented in the prototype could have influenced these results.

The results of the survey indicated that all functionalities were relevant. More than 50 percent of the respondents answered that they would 'definitively' or 'to a lesser extent' use them (Figure 11.6). Further, the survey provided a formative focus on what functionalities might be missing, i.e. a search engine, newsletters, push-functionalities, overview of content (publications), sharing on social media and practice-oriented versions of the publications.

11.4 REFLECTING ON THE RESULTS

An important outcome of the survey is the focus on 'the problem of relevance', which is related to the way scientific knowledge is presented in the generic pathway. Since Study B (Section 5.3.3) pointed out that SMEs are most likely to look for new knowledge for one of two reasons (an inspirational search versus a purposeful search), there has been a recurrent discussion in the thesis about how to best present scientific knowledge to SMEs. The concept of the interface (the generic pathway) builds on the idea of 'inspirational search', for example through the presentation of scientific knowledge by subjects and the swiping functionality. While Study D indicated that SMEs were very enthusiastic about the inspirational search, for example by rendering a Tinder-function 'need-to-have' (see Table 7.2), Study E indicated that they were more reluctant about this idea (see Section 9.3.2). As the Evaluation Study has now pointed out, while the concept of the generic pathway is generally well received, it might be too difficult to find specific and relevant knowledge. SMEs might need a better balance between inspirational and purposeful searching, which is also in accordance with the results of Study B. These results indicate that the inspirational search is too determinative in the interface, and that the purposeful search should be given greater priority, at least as a supplement to the inspirational search. The exemplifying quotes of this study also illustrate this, i.e. by stating that 'It has to be easier to find something relevant' (Quote 4), or 'The theme-division works really well and when you click on a theme it could be really great with an overview of the content' (Quote 11) and 'It is important that there is a good search functionality with filters' (Quote 12). In the current form, the generic pathway seems to be 'too inspirational' and does not take into account the SMEs that search for knowledge in relation to a specific problem, which was in fact rendered very important in Study B. As a result, a better balancing between inspirational and purposeful searches could be implemented in future versions of the generic pathway.

As Quote 5 mentions, 'because scientific papers are presented in another way and in another forum, does not make it easier to read and translate into practice'. This is a valid point. While the generic pathway presents scientific knowledge in a new and different way, the scientific publication itself is still the same. It relates to the type of communication being offered in the interface, which was discussed in Section 10.3. While the development of the interface builds on an interactive communication process, the type of communication offered in this interface is not extremely interactive or dialogical. While guidelines to incorporate experience dimensions into titles and annotations have been developed (see Table 8.2), these do not change the scientific knowledge product. For example, the interface does not allow SMEs to participate in the creation of the message (the scientific knowledge). It was a consequence of the understanding that the first important task was to catch the attention of SMEs, which Study B showed a need for. For example, a respondent here mentioned that: "You would definitely catch my attention 100 percent better visually than if you write a report with 100 pages. Sure, I will read that report if you have caught my attention, but you have to catch it first" (see Section 5.3.7.2). However, as Quote 5 of the Evaluation Study indicates, it is not enough. Although it is only one quote out of 121 responses, it reintroduces the need for the university to be clear on whether they are willing to put time, efforts and resources into the challenge of disseminating scientific knowledge to SMEs, which was mentioned in both Study B and throughout the Development phase. On a similar note, Quote 13 requested 'versions of the publications that were targeted practice – that means that they can be read and understood by regular mortals'. This idea has been brought up before, i.e. in Figure 5.12 where a how-to manual with a short and precise presentation of reports and papers was suggested. These ideas also indicate that a larger change in the production of scientific knowledge, and not only in the presentation thereof, is actually required if dissemination of scientific knowledge to SMEs is to be truly successful. This will be brought up in a discussion in Chapter 13.

The 'Find researchers' functionality got the least positive response in the survey. While 16 percent stated that they would definitely use this functionality, 36 percent stated that they would, but to a lesser extent. Including a module that presented researchers was a way to incorporate aspects of a relational pathway into the generic pathway, which previous results of this thesis have suggested might be profitable (see Section 5.3.2). Because the Evaluation Study is of a mainly descriptive character, the data does not allow for the result to be explained. Accordingly, it could be relevant with a follow-up qualitative study that could explain it. Is the lack of popularity about the functionality itself or about the design of the functionality?

As mentioned above, the results of the survey showed that 45 percent of the respondents did not immediately think that the generic pathway offered knowledge that was usable, accessible or relevant in their work (Figure 11.7). According to the intention behind the generic pathway, this is disappointing. While the data does not allow me to explain these results, I do believe that it – at least partly – has to do with the type of subjects that were included in the prototype. As mentioned several times already, the subjects were limited to regarding the overall business conduct that could be deemed relevant across trades. While there were several good reasons for this (see Section 8.2.1), a negative consequence might very well be that SMEs find it too general to be useful, which Study A also illustrated to be a known problem (see Section 4.2.5). Further, I believe this result reflects a bias in the design of the survey. As mentioned in Section 3.3.6.1, it was challenging to decide how to visualise the generic pathway to the respondents of the survey. My fear was that if I asked them to visit the interface on their own, they would not return to finish the survey, and if I only showed them screen-shots, they would not get a proper understanding of the concept or functionalities. Therefore, I ended up choosing to show them a video. While the pilot study did not indicate this as problematic, the results of the survey have made me aware that the respondents are actually not informed about the work that was put into reorganising the titles and annotations of the generic pathway, including the incorporation of experience dimensions (see Section 8.2.3). As a consequence, the respondents are unaware that parts of the content of the scientific knowledge have been reorganised. Had I offered the respondents the option to go to the interface and browse around on their own, they might have got a better understanding of this.

As a concluding remark, I do believe that the Evaluation Study has provided valuable understandings of relevance to the answer of the research question. However, it has provided what I will characterise as preliminary and indicative understandings of aspects of SMEs' short-term attitudes towards the generic pathway. The study has indicated what works and what should be further developed. However, the results of the Evaluation Study are not without their limitations and biases. I believe the reason for this is mainly to be found in the methods of the study, which is why the next section is devoted to discussing methodological issues.

11.5 METHODOLOGICAL REFLECTIONS

This study has been challenging to conduct, from drawing a sample to finding respondents to deciding on the (amount of) content in the survey. All parts have been challenging, and I believe the results reflect this. Accordingly, it is important to the quality and validity of the study to reflect on limitations, biases and methodology.

First, this study has been a quantitative exploratory study of SMEs' short-term attitudes towards the interface. It can be characterised as a preliminary evaluation, as there are several aspects that are not accounted for. For example, the survey only provides insights into what SMEs immediately think and not what their actual actions would be. It introduces a distinction between attitude and action. For example, just because the SMEs state that they like the generic pathway, it does not necessarily mean that they would also use it. It could be considered a limitation of the Evaluation Study that it does not say anything about actual actions or the long-term effect of the generic pathway. This would, however, require a different type of evaluation design. For example, the generic pathway could be launched and Google Analytics could be used to draw data on the actual users and their use of the generic pathway over a longer period of time. This would provide more accurate insights to actions and long-term effect rather than implications on short-term attitudes.

There is no doubt that the Evaluation Study has its biases. While I believe the sampling strategy for the study is valid (Figure 3.3), it would have been preferable to have known the exact population of SMEs in Northern Jutland and draw a sample from there. As mentioned in Section 3.3.6.2, this was unfortunately not possible. Further, a larger sample and a larger response rate would have added to the validity of the study, although the response rate at 30,63 percent is arguably acceptable. The relatively high drop-out percentage of 37,2 bears witness to SMEs being very careful with their time. If they render something irrelevant or too time-consuming compared to the output, they will drop it. Although this thesis has conducted four studies where SMEs have participated, I am surprised at how challenging it was to find participants and to collect responses for this study in particular. Referencing earlier studies that have directed surveys at SMEs and received relatively small response rates indicated that others have experienced the same problems with this particular target group (see Section 3.3.6.2). Accordingly, using an online survey as a research method might not be the best way to go when the respondents are made up of SMEs. Although qualitative studies are more time-demanding for SMEs to participate in, it was nevertheless easier to find participants for these studies. While the intention to include a larger number and variety of SMEs in the Evaluation Study is reasonable, I believe the outcome of the qualitative studies with SMEs were more informative. This is of course not only a result of the survey as a research method, but also of the decisions I made in the process. For example, due to my previous experiences with SMEs as respondents, I was very focussed on keeping the survey as short as possible, which resulted in important aspects being left out. The best example of this was the lack of illustration of the titles and annotations, which had been reorganised according to the experience dimensions. The video for the survey ended up completely leaving this aspect out, which is why it is actually difficult to use the study to say anything about whether SMEs think that the generic pathway presents knowledge that is relevant and usable, which was an important part of this study (SQ6). Also, as I stated in Section 8.2.7, I would have liked to learn more about whether SMEs found this type of titles and annotations – with its orientation towards spontaneity and other experience dimensions – to be positive or negative. However, I cannot conclude anything on this matter based on this study. In Chapter 13, I will discuss how future studies can address this.

Further, the data from the quantitative survey lacks the ability to elaborate on the results. Actually, I found the quotes from the open text-boxes very informative, which was only a supplement to the primary data of this study. In my perspective, the survey lacks the in-depth perspectives of individual SMEs, which is a consequence of the method but also of me being very focussed on keeping it as short and easy to answer as possible. If I had to do it again, I would focus more on getting supplementary elaborations, although it might cause even more respondents to drop out during the survey. For that reason, I believe a qualitative evaluation is more suitable for future research endeavours regarding SMEs. While this is the last study of the thesis, an idea for potential future iterations is to supplement the insights of this study with qualitative follow-ups.

CHAPTER 12: CONCLUSION

The research conducted in this thesis has been based on the fundamental assumption that *scientific knowledge is in fact relevant to SMEs*. Through various processes of (1) examining, (2) developing and (3) evaluating the dissemination of scientific knowledge to SMEs, the thesis has aimed at answering and contemplating the following research question:

HOW CAN EXISTING SCIENTIFIC KNOWLEDGE BE DISSEMINATED TO SMES USING GENERIC PATHWAYS?

In asking *how* scientific knowledge could be disseminated to SMEs, the goal was not only to examine how it was done at present, but also to explore how it could be done in the future. Specifying that it had to be *existing* scientific knowledge and using *generic pathways* was a way to accommodate the predefined conditions of the PhD project and to separate the focus of the thesis from existing research on the topic. The research question was supported by six sub-questions. Summarising the answer to each of these will help conclude the research question and make the contributions of the thesis clear.

The first sub-question was: **What problems and solutions are known and addressed in relation to the dissemination of scientific knowledge to SMEs?** The Literature Study showed that existing literature tends to focus on barriers rather than solutions, which in itself indicated a need to explore new solutions. Further, the study resulted in an overview and classification of the known barriers to the dissemination of scientific knowledge between universities and enterprises, including SMEs. The categories were: (1) The size and resources of the enterprise, (2) Cognitive and social distance, (3) Communication, (4) Organisational structure and culture, (5) The characteristics of scientific knowledge, and (6) Rights and confidentiality. Further, a contribution of the study was that it showed that a substantial portion of these barriers required a communicative solution. This made it clear what barriers the university could affect and which were related to situation in the SMEs.

The second sub-question was: **What characterises the situation of SMEs and their relation to (scientific) knowledge?** As a consequence of the mainly interpretive research conducted in this thesis, a focus on the specific, situated meanings and meaning-making practices of actors in a given context has been prioritised. While the study of SMEs' situation related to (scientific) knowledge confirmed several well-known understandings analysed in the Literature Study, it also contributed with new and nuanced insights about the perspectives of SMEs and their preferences regarding external knowledge acquisition. It showed that SMEs experience knowledge as being very important to them and that they generally distinguish between two types of knowledge: (1) Experience-based knowledge (know-how), which relates to how to perform a task or a job-related problem, and (2) technical knowledge (know-that), which is a more theoretical knowledge, i.e. about the market, the consumers, theories, regulations, prices and technologies. It showed that SMEs used several different channels to find new knowledge, including both relational and generic pathways. The study further resulted in some characteristics for SMEs' preferred knowledge product: Knowledge must be easily and quickly accessible, personalised, experience-based and specific (according to the business or market area); cost-effective (due to a lack of resources); providing both experience-based and technical knowledge; and experimenting with incorporating relational pathways (or features thereof) into generic pathways. Further, two types of searches were identified – the 'purposeful search' and the 'inspirational search', which were brought on by SMEs looking for new knowledge primarily for one of two reasons: (1) When they had to solve a pressing problem or task, thus looking for precise information, or (2) when their task was to update their knowledge and find inspiration by looking for new ideas, technologies, processes and products. Further, the study elaborated on the constant time, resource and development pressure that SMEs face, and it provided an analysis of the barriers to knowledge in general and to scientific knowledge in particular, which both confirmed and elaborated on the findings from the Literature Study. Finally, it clarified SMEs' understanding of universities and scientific knowledge and discussed the positive and negative implications on the dissemination process.

The third sub-question was: **What are the communicative principles for the dissemination of scientific knowledge to SMEs?** As a result of this sub-question, four communicative principles for the optimised dissemination of scientific knowledge to SMEs were created. Scientific knowledge must be (1) Promoted, (2) Reorganised, (3) Concretised and (4) Provided. This contribution adds to existing knowledge on the field and provides instructions on how scientific knowledge could and should be disseminated to SMEs.

The fourth sub-question was: **How is existing scientific knowledge presented and organised in a Research Information Management System (a generic pathway), and how does it correlate with the preferences of SMEs?** The thesis has exemplified the different types of data that are available in VBN. The study in Chapter 6 demonstrated that existing scientific knowledge can be accessed according to content categories ('Researchers', 'Research', 'Research projects', 'Activities', 'Press clippings' and 'Research units'), and that these content categories were interrelated and consisted of different types of content such as uncontrolled indexing terms (i.e. publication abstracts or keywords), graphs of relations, full-text versions (when available) and graphs of social media activity. The study argued that VBN did not necessarily organise scientific knowledge in a way that makes sense to SMEs. The web interface of VBN was primarily text-based, it offered limited ways to categorise the search results, it did not clearly illustrate what subjects of scientific knowledge might be of relevance to SMEs, and it did not provide information or instructions on how the content could be converted into practice and used to solve work-related problems.

The fifth sub-question was: **How can a generic pathway disseminate scientific knowledge based on an understanding of the situation and preferences of SMEs?** The thesis exemplified and concretised how scientific knowledge could be disseminated to SMEs through a generic pathway by developing a prototype of an interface based on SMEs' intersubjective perspectives. The studies of the Development phase showed that SMEs are actually interested in scientific knowledge, and that they do request the type of knowledge (explicit and encoded) that can be provided through generic pathways and not only the type of knowledge (tacit and embodied) that can be provided through relational pathways, such as collaboration. Focussing on SMEs' use and valuation of generic pathways in relation to the acquisition of scientific knowledge added to existing literature in the field. The studies showed that incorporating experience dimensions to the interface and attempting to design for a refined, pleasurable and meaningful experience could be a way to meet SMEs' preferences for scientific knowledge. The contributions of this part of the thesis were: (1) A discussion on how existing scientific knowledge from VBN could and should be (re)organised and presented, i.e. according to subjects rather than persons; (2) an analysis of the types of information and functionalities that were needed in order to meet SMEs' preferences; and (3) an exemplification of how titles and annotations could be reorganised.

The sixth and final sub-question was: **To what extent does the generic pathway that is based on an understanding of the situation and preferences of SMEs make scientific knowledge appear more accessible, understandable, relevant and usable to SMEs?** The Evaluation Study showed that SMEs' positive perspectives on the interface were that it was 'concrete, easy, manageable, a good entrance, relevant, usable, accessible, informative and educative'. It also indicated that all functionalities (find and read publications, watch videos, find researchers, find other links about a subject, save and share publications) were relevant, but that the 'problem of relevance' needed more attention.

In conclusion, the processes of examining, developing and evaluating have explored how existing scientific knowledge could (and should) be disseminated to SMEs using generic pathways and thus provided an answer to the research question. The thesis has outlaid the principles, characteristics and preferences that should be understood and taken into account in order to optimise the dissemination of scientific knowledge according to SMEs themselves. Understanding SMEs' preferences for the dissemination process – and taking action on it – is a central contribution of the thesis. The thesis has explored how scientific knowledge could become accessible, understandable, relevant and usable to SMEs, and it has explored how these preferences could be concretised and what the effects were.

Regarding the initial assumption – that scientific knowledge is in fact relevant to SMEs – the studies of the thesis have shown that explicit and encoded scientific knowledge disseminated through a generic pathway *was* rendered relevant by a variety of SMEs. However, the thesis has also demonstrated that it is difficult to make an unambiguous declaration regarding this assumption. Certain reservations have to be made. The thesis has shown that it depends on several characteristics such as type of scientific knowledge product (explicit versus tacit), type of channel (generic versus relational) and type of SME (size, trade, location). Illustrating the many variables influencing the success of the dissemination process is another contribution of the thesis.

As a consequence of the explorative and interpretative research conducted in the thesis, the answer to the research question cannot be considered definitive nor unequivocal. While the studies conducted in this thesis have allowed for important understandings and perspectives to surface, other studies could have provided other perspectives or aspects of the problem area. By that, I believe that a conclusion for the research question has been provided, but I do not consider this area of study to be concluded. Further development and more explorative initiatives should be undertaken, for example regarding how to promote scientific knowledge to SMEs, which was one of the communicative principles provided by the thesis. While I have explored a concrete dissemination solution and the underlying principles thereof, this does not solve the substantial problem of how to draw SMEs' attention to scientific knowledge. This and other relevant subjects could (and should) be explored further, and for that reason, the next and final chapter of the thesis will reflect on ideas for further research as well as discuss some final important conditions.

CHAPTER 13: FURTHER PERSPECTIVES

During the course of the thesis, several ideas for other perspectives and further studies have emerged. Before I bring the thesis to a close, I will briefly introduce some of these, thereby also explicating what I believe to be the next necessary steps within this area of study.

13.1 PROMOTING SCIENTIFIC KNOWLEDGE

In the beginning of this PhD project, I expected the communicational aspect to weigh much heavier in the research focus than actually ended up being the case. In particular, I expected the main focus to be on how scientific knowledge could be marketed and promoted to SMEs. With the predefined conditions of the PhD project, I was given the assignment to examine how the specific type of knowledge that exists in the Research Information Management System of Aalborg University could be disseminated to SMEs. Because this knowledge is explicit and encoded, it is arguably more difficult to disseminate and make relevant and useable to users, which the thesis has discussed on several occasions. However, I approached the assignment with an understanding of it being essential to learn more about the users in order to develop a functional solution, which is why I ended up studying the situation of SMEs. By that, the focus moved from primarily exploring how to *promote* scientific knowledge to how to *understand* the users and how to *organise* and *present* scientific knowledge accordingly. The focus on marketing and promotion of scientific knowledge was thus downplayed, although the importance of it has been pointed out several times throughout the thesis. However, further studies could very well explore how this promotion of scientific knowledge could be done. It is given that the problem of disseminating scientific knowledge to SMEs is not done merely by developing an interface. Showing SMEs that this interface exists and what the benefits of using it are is essential to the success of it. Initially, I had the idea to work with physical experience designs in SMEs' own environments in order to create a new type of awareness and engagement with scientific knowledge. For example, I imagined that I would create a physical design that could be brought to places where SMEs already interact (i.e. network arrangements, industry shows or even canteens), which could ensure that scientific knowledge would 'find them' (and not the other way around) and draw attention to its relevance in new ways. Although this was never realised within the PhD project, I believe it could be a great way to explore the promotion aspect of the problem area in the future.

13.2 THE SITUATION OF THE SCIENTIFIC WORLD

While this thesis has focussed on the situation of SMEs (the receivers), another aspect of the problem is related to the university and the individual researchers (the senders). As already mentioned, disseminating scientific knowledge according to the preferences of SMEs is not done solely by understanding SMEs' preferences nor by developing an interface specifically for them. There is no way around accepting that the universities and the individual researcher have an important part to play if the dissemination of scientific knowledge to SMEs is to be successful. Because SMEs need scientific knowledge to be reorganised (Chapter 5) the success of the dissemination process depends on whether the university and the individual researcher are capable and willing to produce (and report) knowledge that meets requirements other than those of the scientific world. Studies of the thesis have proved this to be necessary on several occasions, for example in Chapter 5, where a respondent suggested a 'how-to manual with a short and precise presentation of reports and papers' (Figure 5.12) and in Chapter 11, where a respondent requested 'versions of the publications that were targeted practice' (Section 11.2). In other words, a larger change in the *production* of scientific knowledge and not only in the *presentation* and *organising* thereof is required if dissemination of scientific knowledge to SMEs is to be truly successful.

This is, however, not unproblematic. A big part of the problem relates to the circumstances of researchers, which has not been analysed in this thesis but could be an idea for future studies. For example, conducting a study on 'the situation of scientists', using a similar research design as Study B of this thesis, could be an interesting next step. Researchers have a dual role. On the one hand, they are hired to do research and produce new knowledge. On the other hand, they are expected to disseminate this knowledge to society. The latter is challenging, because there is often a lack of guidelines regarding how and when to do it. As argued in the Bodmer Report (Bodmer, 1985), researchers must learn to communicate with the public, be willing to do so, and consider it their duty to do so. This raises three questions: Are researchers able to communicate their research; do researchers want to communicate their research; and why should researchers communicate their research? These questions deserve a little reflection.

First of all, as stated by Weigold (2001), while researchers are great at conducting science, they are not necessarily great at disseminating it, at least when the audience is the general public. Research is often conducted (and financed) with a scholarly goal in mind and within a specific context, and researchers can find it difficult to translate ideas from the technical language of their discipline into a language understandable to a wider audience (Claessens, 2008). According to Weigold (2001, p. 179), "Scientists are specialists, involved in the minutia of a specific problem that may represent a small piece of a much larger puzzle. This can make it difficult for them to state why their most recent discovery is a newsworthy event or even a significant development". Furthermore, time (and money) is often not allotted for this process. Thus, relying on researchers to be capable of communication is problematic (Burchardt, 2007). Second, Weigold (2001) states that researchers are often reluctant to engage in public dialogue. One reason for this is that publishing popular science has traditionally been given little informal approval from researchers colleagues (Cronholm & Sandell, 1981; Shortland & Gregory, 1991; Weigold, 2001). Fellow researchers might even look down on colleagues who go public for spending time on popularising scientific knowledge rather than conducting peer-reviewed research. Another related reason is that researchers are rewarded for research and teaching, and only to a lesser extent for disseminating their results to the public. In Denmark, a performance-based model exists, where distribution of grants is based on the production of research-based publications. Accordingly, Danish researchers are awarded for publications – not for transforming the results into popularised news or practice-oriented how-to manuals. Consequently, the willingness to engage in dissemination activities is not necessarily present. Third, disseminating scientific knowledge to society has historically not been part of researchers' job description. That means that they are not obligated to spend time on it, and it is not explicitly their duty.

However, change is happening. More and more, researchers are encouraged to inform society about what they are doing. Davies (2008) stated that at the very least, researchers are now aware of a push toward public communication, and in many cases have taken part in one or more science communication activities. As concluded in a report by DEA (2013), Danish universities are already working on creating more incentives for researchers to engage in collaborations and knowledge dissemination, and they underscore that for researchers to view the dissemination of knowledge as an immediate continuation of their work, it is of vital importance that they themselves have the option to deselect it rather than being forced to do it. Further, researchers around the world are now offered courses in science communication, and universities often have communication units or journalists to help transform science and research into news and popular articles (Horst, 2012a). Nevertheless, the current circumstances of researchers are obstructing the dissemination of scientific knowledge. Political interventions are needed to solve this problem, and the universities have to decide if they are willing to put time, efforts and resources into changing the form, the production and the dissemination of scientific knowledge. The thesis has profiled the dissemination of scientific knowledge as a strategic endeavour, and it is exactly the point: The university has to clarify its intention and ensure that all actions and circumstances are conducive to that intention.

Another problem related to the situation of the scientific world is that of open access (or lack thereof). In the Developing phase of the thesis, I experienced a great hindrance in a large amount of publications not being available to SMEs. In Chapter 5, respondents also mentioned this problem. For example, Respondent 18 stated that: "Published papers are not free and then you have to either use some students who can access it for free or you have to pay for it, and that is all right. But if you have to buy some papers and if you are busy and "oh I have to come up with something new" then you lack the incentive to pay 200 € for a number of papers that you just find online and print out. Then you need clearance to be allowed to use this money on research" (Appendix 2.21). As the quote is illustrative of, facing a paywall will definitely be a barrier to many SMEs, who lack resources and incentive to use scientific knowledge. Exploring the precise consequences of open access (and the lack thereof), for example through a qualitative study where various SMEs get to express their perspectives on the matter, is a relevant and interesting topic for further studies.

13.3 FURTHER DEVELOPMENT OF THE GENERIC PATHWAY

It is important to stress that the solutions explored and developed in this thesis are not finished. As concluded in Chapter 11, further iterations of development and evaluation are required. The interface presented in Chapter 10 is still only a prototype, especially because a lot of the Pure data from VBN had to be manually extracted and reorganised. A solution to this problem will have to be found if the dissemination of existing scientific knowledge through generic pathways is to be successful. In total, further exploration of the possibilities and limitations to generic pathways versus relational pathways (and to explicit versus tacit knowledge) is an interesting topic for further studies. It has been a reappearing issue in this thesis that generic pathways – because they require scientific knowledge to be explicit and encoded – have their limitations. Blackler (1995), for example, cites Lave (1993) when stating that major difficulties occur when educationalists assume that knowledge can be divorced from context and transmitted either as abstract data or as universally applicable approaches to problem solving. This is arguably what generic pathways do and what this thesis has experimented with. While it is important to keep in mind that a generic pathway does not solve all problems, I have however shown that SMEs actually request generic pathways in this context and express a desire to use them. It is therefore relevant to explore the distinctive features, potentials and limitations of generic pathways (and explicit knowledge) in this context further. In Chapter 10, I also mentioned that it would be interesting to further explore how the communication offered in such a pathway could be made more interactive. Conducting qualitative and experimental studies on just how interactive and co-creative scientific knowledge can become in this type of pathway is a very interesting next step to take. In that connection, exploring further how the dimensions of experience design can be implemented and what the effects are would be relevant. A first step could be to conduct a qualitative evaluation study of the current prototype of the interface, focussing particularly on SMEs' attitudes towards the reorganised titles and annotations presented in Chapter 8.

Continuing the development of the generic pathway by including perspectives of more actors would also be valuable. For example, inviting more and other types of SMEs – from other regions in Denmark and maybe even from other countries – could add perspective and challenge/confirm the results of this thesis.

13.4 FINAL COMMENTS

While the Danish science-society debate has increased over recent decades, I believe the focus on the dissemination of scientific knowledge to both business and society will continue to grow in the coming years. According to Baycan and Stough (2013), universities will play an even more important role in innovation processes in the future. The ivory tower is no longer an option (Claessens, 2008), and I expect that we will see universities increasingly embrace their third mission. Aalborg University explicitly wrote into their overall strategy, *Knowledge to the World*, that a special focus should be given to cooperating with small and medium-sized enterprises and to increasing the contributions to SMEs' capacity for innovation (Aalborg University, 2016), which is a great indicator. Exploring further how scientific knowledge can be disseminated and even *exchanged* with SMEs and other external groups is an exciting research area for the future.

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APPENDICES

All appendices have been enclosed on a DVD and are only available to the assessment committee. In the following, the appendices and the appendix numbers that are referenced throughout the thesis are listed.

APPENDIX 1 – Study A

1.1. List of publications included in the Literature Study
1.2. Creating concepts for the Literature Study

APPENDIX 2 – Study B

2.1. Observation guide for the go-alongs
2.2. Interview guide, CEOs
2.3. Interview guide, employees
2.4. Transcript of Respondent 1
2.5. Transcript of Respondent 2
2.6. Transcript of Respondent 3
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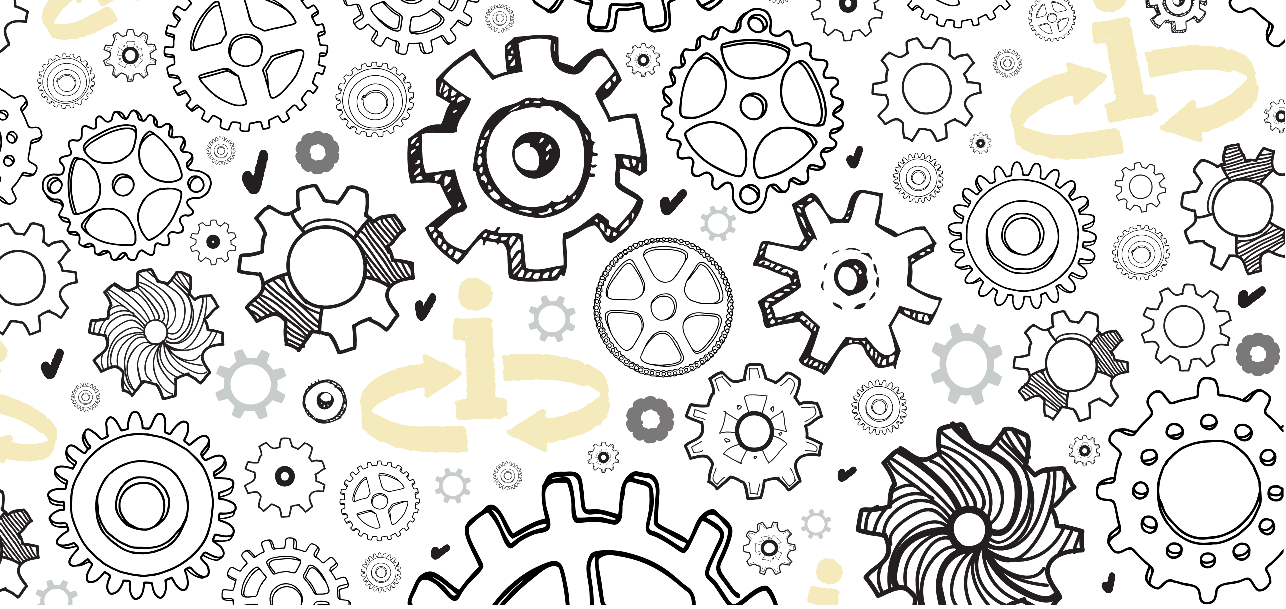
2.29. Transcript of Respondent 26
2.30. Transcript of Respondent 27
2.31. Transcript of Respondent 28

APPENDIX 3 – Study D

APPENDIX 4 – Study E

APPENDIX 5 – Study F



SUMMARY

The science-society debate has increased over recent decades. While the traditional missions of universities are research and teaching, the rise of the knowledge economy has brought on a growing attention to the 'third mission'. Universities are increasingly seen as a source of new ideas, inventions and regional/national innovation and they are now expected to stimulate a greater awareness and utilisation of scientific knowledge outside academia. However, finding successful ways to disseminate scientific knowledge from universities to the outside world is challenging.

Through a number of explorative studies, the thesis (1) examines, (2) develops and (3) evaluates how scientific knowledge can be disseminated to small and medium-sized enterprises (SMEs) through generic pathways. Focus is on the dissemination of existing scientific knowledge in the form of Pure data from VBN, which is the Research Information Management System of Aalborg University. Based on mainly qualitative data, the thesis provides insights into SMEs' perspectives and preferences regarding external knowledge acquisition. This forms the basis for the development of a new generic pathway that concretises and exemplifies how scientific knowledge can be disseminated to SMEs.

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