Experience-Oriented Knowledge Organisation for the Transference of Scientific Knowledge from Universities to SMEs

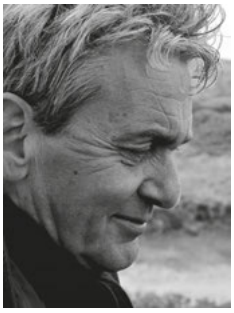
Marianne Lykke*, Sarai Løkkegaard**, and Christian Jantzen***

Aalborg University, Department of Communication and Psychology,
Rendsburggade 14, 9000 Aalborg, Denmark,
*<mlykke@hum.aau.dk>, **<sarai@hum.aau.dk>, ***<jantzen@hum.aau.dk>

Marianne Lykke is Professor at the Department of Communication and Psychology at Aalborg University, Denmark. She teaches classes on information architecture and knowledge organization systems, user experience design, and design methodologies. Her research is focused on usage-centered approaches to knowledge organization. She is particularly interested in the design of knowledge organization in work-place environments and museum settings. Marianne holds a PhD from Åbo Academy in Finland, and a master's degree from the Royal School of Library and Information Science in Denmark.

Sarai Løkkegaard is a PhD student at the Department of Communication and Psychology at Aalborg University, Denmark. Her research is focused on strategic communication and information management, specifically how to use principles from experience design to improve communication and information retrieval. Sarai holds a master's degree from the Department of Communication and Psychology at Aalborg University.

Christian Jantzen is Professor at the Department of Communication & Psychology, Aalborg University (Denmark). He holds a PhD degree in cultural analysis from the same university (1997). His fields of research are media studies, consumer culture, and experience design. He has published twenty papers in peer-reviewed journals, forty-five book chapters, edited seven books, and authored three books.



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Abstract: Transferring scientific knowledge between universities and industry is known to be problematic, specifically for small and medium-sized enterprises (SMEs) that have limited resources and absorption capacity. A variety of channels is used for knowledge transfer. These include what is commonly referred to as generic pathways (e.g., scientific publications) and relational pathways (e.g., faculty consulting). The purpose of this research is to extend our knowledge about the design of knowledge organization for a generic pathway interface providing access to scientific knowledge in a research information management system. The analysis focuses on how to meet the characteristics of SMEs in the design and organisation of the subject terms and annotations in the navigation and searching system. The design is based on findings from a qualitative analysis of eight SMEs and on principles of experience design. Experience design was applied, because the classical KO design qualities seem not to be comprehensive goals for knowledge organisation for a generic pathway interface. The SMEs need guidance, encouragement, and inspiration. Experience designs are designs that have been created to provoke changes in a user's state and behaviour by engaging this user emotionally and cognitively. The paper provides examples and discusses the outcome of the experience dimensions.

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1.0 Introduction

Transferring scientific knowledge between universities and industry is known to be problematic, specifically for small and medium-sized enterprises (SMEs) that have limited resources and knowledge bases for research and development (Ranga et al. 2008; Woolgar et al. 1998). The attention on business size and resources is often related to a firm's "absorptive capacity." Absorptive capacity is a well-known concept within knowledge transfer between university and industry. The term origins from research by Cohen and Levinthal (1990) and refers to a firm's ability to use

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external scientific knowledge. The smaller the firm, the smaller the absorptive capacity. Muscio (2007) and Comacchio et al. (2012) specifically mention that SMEs have less absorptive capacity than larger companies. In this perspective, it can be concluded that SMEs need more help when searching, understanding, and implementing scientific knowledge. A variety of channels is used for knowledge transfer. These include what is commonly referred to as "generic pathways" (e.g., patenting, commercialisation and scientific publications and databases) and "relational pathways" requiring interaction between the knowledge creator and the recipient enterprise (e.g., graduate recruitment and faculty consulting) (de Zubielqui et al. 2015). Ariakan (2009) empazise how inter-organizational collaboration and knowledge exchange may enhance knowledge creation in SMEs toward better innovative outcomes. Liu (2011) adds that inter-organizational cooperation can provide a common pool of resources, opportunities for knowledge flow, and stimulus for innovation. The choice of channel is complex and may be influenced by many different factors. In this paper we focus on the interaction between SMEs and universities and investigate how we can use university research information management systems registering publications, datasets and professional activities as a channel to disseminate scientific knowledge to SMEs. A research information management system is an online archive that aims at synchronising research data across a university and securing online availability. It can be used by both researchers and administrative units to manage and organise digital material. This not only provides better internal reporting at the university, it also provides greater visibility of research activities and supports open access (Dempsey 2014; Givens 2016).

The organisation of documents for the purpose of retrieval has been a long-standing problem for organisations, large and small, in the public and private sectors (van der Walt 2004). Only few studies have focused on knowledge organisation and information retrieval in SMEs. Denner and van der Walt (2004) investigated information needs and information organisation practices of small businesses. The purpose of their investigation was to determine what information should be taken into account when designing internal systems for organizing information in small, medium, and micro enterprises (SMMEs). Their survey showed that SMMEs are aware of the importance of information for their business, but that retrieving information is a problem due to lack of searching expertise and limited time. Traditional organisation tools such as classification systems and alphabetical indexing languages can be used for the organisation and indexing of internal as well as external information, but they should be designed to address the specific needs of SMMEs. According to Denner and van der Walt (2004) key quality criteria for SMMEs are closeness to business processes, recognisability, guidance how to use the system, and use of a single, common system for all document collections. Based on these findings, van der Walt (2004) later developed a generic classification scheme for SMMEs based on common business processes, e.g., general management, finance, human resources, production, marketing and sales, etc.

The present research takes up the challenge of developing knowledge organisation systems that meet the specific needs and characteristics of users in SMEs. As opposed to previous research we focus on the external retrieval of information from universities. The purpose is to extend our knowledge about the design of knowledge organisation for a generic pathway interface built on the top of a university research information management system for university-industry knowledge transfer. We concentrate our analysis on the organisation of knowledge—specifically how to meet the characteristics of SMEs in the design of access points (subject categories in the website navigation system and subject terms for the search system) and in the description and organisation of the scientific knowledge by controlled and uncontrolled keywords and descriptive annotations (Haynes 2018; Lampe 2007). The goal is to allow the SMEs to search and access the scientific publications from their specific perspective as suggested by Denner and van der Walt (2004). The paper addresses the following research objective:

> How do we design the knowledge organisation of a generic pathway interface that supports knowledge transfer in the form of scientific publications between universities and SMEs? How do we design and organise the subject access points in the navigation and searching system, and how do we describe the scientific publications so that they meet the information practice and absorption capacity of SMEs?

We base our suggestions on a combination of knowledge organisation theory (Rowley and Hartley 2008), principles of experience design (Hassenzahl 2010), and findings from an empirical study of the information practices of eight SMEs (Løkkegaard and Lykke 2016). In the empirical study, we study the situation and information practice of SMEs to be able to meet the specific characteristics of SMEs. We use knowledge organisation theory to understand and transform the findings to knowledge organization design. We apply experience design principles to knowledge organisation principles, because the classical design qualities for knowledge organisation such as coverage, completeness, exhaustivity, specificity, recency, and relationships (Lancaster 1998) seem not to be comprehensive goals for the generic pathway for SMEs. Due to their small absorptive capacity, SMEs need assistance when they search and direction how

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to use the information. They also work with limited resources in terms of time. Suggestions and inspiration are requisite qualities for the knowledge organisation. Experience designs are designs that have been created to provoke changes in a user's state and behaviour (physiologically as well as emotionally) thus challenging previous perceptions and routines (cognitive aspects) (Jantzen et al. 2011). We want to investigate whether we can use these qualities of experience design to make the knowledge organisation more engaging and motivating.

The remaining paper will consist of four parts. In the first part, we present the research design. In the second part, we present the experience design principles and discuss what qualities experience design can bring to knowledge organisation. The third part presents the findings from the study that informed the design of the knowledge organisation. Finally, in the fourth part, we will present and discuss how the experience-oriented knowledge organisation may support the transference of scientific knowledge from universities to SMEs.

2.0 Research design

We chose a qualitative and exploratory approach for our research and were inspired by the concept of "situational analysis" (Clarke 2005). Situational analysis offers an empirically and epistemologically sound approach to the study of social life through qualitative research. In situational analysis, the action-centred "basic social process" is replaced with a situation-centred "social world/arenas/negotiation" framework. The idea was to study the situation of the target group to identify problems and potentials as identified by SMEs themselves when they are in situations acquiring some form of information (Løkkegaard and Lykke 2016).

During the design process, we carried out several iterations. First, we carried out the situational analysis, then we presented our findings and design suggestions at a workshop with a group of SMEs. Afterwards, we developed a first sketch of an interface design and knowledge organization based on the workshop findings. This sketch later underwent usability testing by employees from the participating SMEs. In the present paper, we present the findings from the situational analysis and the workshop and discuss how they have been transferred to experience-oriented knowledge organisation and interface design.

The study involved three data-collection methods: 1) introductory interviews with the eight CEOs to get an understanding of the enterprises' missions, goals, and overall working methods; 2) eight walk-along (walking observations and interviews (Kusenbach 2003)) where we conversed with the CEOs and employees, observed and experienced the informants' ways of working and their information practices; and, 3) twenty-nine semi-structured interviews with employees at the eight SMEs to get their view on their everyday situations and processes at work and to learn about the interviewees' relationships with universities and scientific publications. More specifically, we asked into the situations in which they experience a need for information, what kind of information they look for, what channels they use, if they have ever used scientific knowledge in their current work, and what obstacles/potentials they have experienced that are related to finding and using information in work situations. The interviews ranged in length from nine to sixty-one minutes, and all of them were audio-recorded and transcribed. Together, these data provided an in-depth understanding of the information practices in the SMEs and allowed us to suggest various characteristics for their general practices. We conducted a thematic analysis (Gibson and Brown, 2009), where we searched for aggregated themes within the data. We categorised the unedited quotes from the thirty-seven interviews and after several iterations, each quote was made into a theme, which allowed for a statistical representation of the data. This will be the point of departure in our analysis. Note that not all of the informants talked about all identified themes. The number of informants and number of quotes (n) will be indicated in each of the following figures.

After analysing the data from the situational analysis, we organized a workshop with the aim of specifying criteria for the knowledge organisation. Twelve informants participated in the workshop: seven participants from the SMEs, three participants from the university research information management system, and two university professors publishing scientific publications and participating in knowledge transfer. The two researchers organised the workshop with three external web designers who were in charge of coding the interface of the generic pathway. The workshop consisted of three parts, one focusing on content using the card-sorting method to describe and organise the content, one focusing on navigational functionality using blueprint sketching, and the last workshop where the workshop groups were asked to sketch the groups' "dream access and interaction" (Preece et al. 2015). The informants were divided into two groups during the workshop with six informants per group.

3.0 The concept of experience

We start by a short presentation of the experience design principles. Experience design is based on the notion that experiencing is a holistic process (Jantzen 2013). An experience consists, firstly, of physiological, perceptual, emotional, and cognitive aspects and is more than the sum of these parts. Secondly, holism means that experiencing something pleasurable or painful may make one become (more) experienced. Linguistically, this holism is expressed in the dual

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purport of the noun "experience," which in most Germanic languages is translated into two different words: e.g., the German *Erlebnis* (an awareness of interacting with the world you are having right now) and *Erfahrung* (a form of knowledge derived from interacting with the world). *Erlebnisse* are what we are experiencing here and now, *Erfahrungen* are the digestion of key *Erlebnisse*, which have made "me" into what "I" am (Bradley 2005). *Erfahrungen* are based on past *Erlebnisse*. And in reverse: past experiences (*Erfahrungen*) may guide, frame, or tune future experiences (*Erlebnisse*). Past experiences (*Erfahrungen*) create expectations of coming experiences (*Erlebnisse*). But, thirdly, an *Erlebnis* typically stems from a deviation from these prior expectations. *Erlebnisse* are generated by the qualitative and quantitative difference between what we expected to happen and what actually occurred.

From this holistic notion of experiencing the following definition is derived: an experience is a change in an individual's physiological (pleasure or pain) and/or affective state (relief, anger, anxiety, excitement, etc.), bringing about perceptual and/or behavioural changes (e.g., increased awareness or altered conduct), which may challenge or charge previous experiences potentially leading to new understandings or expanding existing ones (Jantzen 2013). The experiencing process may thus lead to learning something new.

This definition implies that the concept of experience comprises more than sensations and emotions. Experience is the transposition of affect into cognition. Experiential qualities are not only about fun, pleasure, and wellbeing (or their opposites). They are also about expectations and about learning something new from those sensations that differ from the expected, i.e., about cognition and identity. This is what philosophy has pinned down as the field of aesthetics. Aesthetics is cognition by other means than ordinary reasoning; it is cognition through the senses (Kant [1790] 1973). The purpose of aesthetics is not to produce pleasing sentiments but to bring about an understanding of the world and the self by means of bodily involvement: through sensations and emotions.

This connection between aesthetics and experiences was highlighted by Dewey (1934). Just like art, he stressed, true experiences presuppose a balance between passively undergoing stimuli from the environment and actively doing something in respect to this environment. This corresponds with insights from motivation psychology indicating that experiential value is derived from hedonic pleasures (passive, reactive) as well as from engagement (active) (Higgins 2006). The user's activity is just as seminal to experiencing as indulging in pleasurable stimuli. Another important contribution from motivation psychology sheds more light on the nature of "doing" in art as well as experiencing. Contrary to activities directed towards an external purpose, "doing" in the aesthetic mode has no purpose outside the activity. Whereas goal-directed activities are "telic," aesthetic activity having no ordinary utility is "paratelic" (Apter 1989). Like in playing, one "does" for the pleasure of "doing," and while "doing" the activity in this manner one may easily forget the original purpose of this "doing." In a famous wording in the philosophy of aesthetics, purely experiential activities could be seen as "purposefulness without a purpose" (Kant [1790] 1973). The concept of "flow" seems to capture the aesthetics of these experiential "doings" (Csikszentmihalyi 1991).

4.0 Ten experience dimensions

From this psychologically defined concept of experience, a set of ten dimensions for designing and evaluating users' experiences can be deduced (Jantzen et al. 2011). Because experiencing is a bodily process engaging the senses and arousing emotions a design has to be "involving," i.e., it has to be entertaining. It has to enhance positive moods and diminish or reverse a negative mood. Entertainment serves mood management (Zillmann 1988). Physiologically, involvement implies a change in the body's arousal level: a decrease leading to relaxation or an increase of stress heightening awareness. On the emotional level, such changes broaden the scope of attention and may promote a seeking behaviour (i.e., curiosity) (Frederickson 2001).

Next, a design has to divert the user from his or her preplanned goals. The design becomes the goal in itself and not a tool for reaching an external goal. The design becomes playful and the user's behaviour (a "doing") is oriented towards this play. It becomes "paratelic" (Apter 1989). The dimension "spontaneous" captures this dimension, i.e., to what extent is the design able to promote non-goal-directed behaviour?

Experiences are the outcomes (*Erfahrungen*) of a bodily process of experiencing (*Erleben*) by which affects are transformed into cognitions. This fact is expressed in two further dimensions. A design has to be "interesting," i.e., it has to challenge expectations formed by prior experiences. This dimension puts ordinary perceptions and conceptions of the world at stake. It could be called "cognitive involvement" whereby otherwise familiar assumptions are "made strange," unfamiliar. A main function of aesthetics is to divert ordinary perception and habitual awareness (Shklovsky [1917] 1965).

The contrasting dimension of this de-automatization of expectations is the dimension "relevant." Relevance assures that the challenge remains understandable as well as manageable. The deviation disrupts expectations, but it can nonetheless be handled within the established cognitive structures, the experience based mental models (Johnson-Laird 1983), schemata (Rumelhart and Ortony 1977),

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or scripts (Schank and Abelson 1977). A relevant design without interest is not experiential. An interesting design without relevance will at best have only very few users. Experience-oriented design thus has to find a delicate balance between these twin dimensions. To use an analogy, interesting and relevant experience design is like a riddle. A "good" riddle should beg to be solved (i.e., it should be interesting). But it should also convey the impression on its audience that they are actually capable of solving it and that the problem solving will be worthwhile (i.e., it should be relevant).

Experiences are "lessons" learnt from experiencing. A further dimension is thus "learning," i.e., the ability of the design to integrate interest and relevance in revised cognitive structures. This dimension evaluates in how far the entertaining qualities of the design contribute to the user's development, to identity, and habit formation. New experiences expand the existing ones. This elaboration of cognitive structures is "accommodation" (Piaget 1985).

A sixth dimension is "unique." This dimension is a quality in the design as perceived by the user. It is related to the "novelty" aspect of those experiences that deviate from the routine. The design's degree of perceived singularity and attributed originality may be a motivating factor for user involvement and interest. The unique is exceptional by being non-repeatable (e.g., events), non-reproducible, or strictly time and space defined (e.g., rituals and sanctuaries).

The dialectics of "undergoing" and "doing" in experiencing, pointed out by Dewey (1934), leads to the final psychologically derived dimension: "interactive." An experience is not something bought and sold or designed and used by two distinct agencies. In fact, viewed as psychological phenomena, experiences are actively produced by the user, who utilizes both the design and his or her own expectations in this process. The core of experience design is therefore not only a matter of involvement, but also of user participation. Such participation is mental as well as corporeal. And the quality of this dimension is expressed by the degree in which this participation alters the mental representation and physical shape of the design. The importance of interactive qualities has been stressed in managerial studies as well as in design theory under the labels of "co-creation" and "co-design" (Prahalad and Ramaswamy 2004; Sanders and Stappers 2008).

Experiencing the world by sensing and engaging the environment is a prerequisite for maintaining biological existence. And learning from such experiences is most certainly a universal human feature. In modern Western societies, though, having experiences appear to have become a main goal in life to such an extent that experiencing can become commodified (Pine and Gilmore 1999). "Experientiability" has thus become a determining factor for products' success. An early analysis of how these changes generated a new notion of what the meaning of life basically is, is Schulze's seminal sociological study (Schulze 1992). The main assumption of this study may be summarized as follows. In the "experience society," experiences are no longer contingent by-products of processes of social exchange (e.g., production and consumption). Instead, experiences become either the very goal of these exchanges (e.g., in hedonism) or a token of proof that the user is existentially on course towards some non-material goal (e.g., self-actualization). This latter utilization of experiences in everyday behaviour could be dubbed a neo-romantic tendency (Reckwitz 2006), whereas the former could be called a symptom of neo-utilitarian materialism. In this case people use design for the sake of optimizing pleasure. High scores of the dimensions "involving," "spontaneous," and "interesting" will be indicative for the pleasure optimizing goal. A supporting, supplementary dimension could be "fun."

On the other hand, high scores on "interesting," "relevant," and "learning" indicate that experiences are meaningful testimonies in the pursuit of self-development. Another two supplementary dimensions express this evidence-oriented utilization of experiences in identity-projects: "close" and "authentic." A high score on "close" expresses that the design is felt to address issues and concerns that the user finds significant for his or her life and that this address seems to be tailored to match the user personally. Examples of how this dimension is being practiced are customization and social media communication. "Authentic" expresses that the purpose of the design is felt to be "for real" and that its intentions are trustworthy and reliable. Authenticity is a (neo-romantically inspired) demand in that it prefers scrutinizing motives of acts at the cost of examining their possible consequences. It is preoccupied with the sincerity of a specific statement and of its utterer.

The three supplementary dimensions could be said to be culturally specific. They are relevant for evaluating designs circulating in societies where experiences are valued as if they were commodities, i.e., in experience economies (Pine and Gilmore 1999), or where technology significantly enhances the production of experiences (Wright and McCarthy 2004). On the other hand, we assert that the first seven, psychologically derived dimensions have a universal character. They are independent of societal and cultural issues, economic agendas and technological innovations. We therefore consider them to be the basic dimensions. The ten experience dimensions are summarized in Table 1.

Organizing knowledge in accordance with these dimensions may motivate users to initiate, prolong, and repeat their search activities, firstly, because searching becomes engaging and thereby more intrinsically rewarding (Higgins 2006; Ryan and Deci 2000). The pleasurability of

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Dimension	Key issues
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 for its users? 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 personalized?
Authentic	Does the design evoke an impression of sincerity in its user? Is it true to its purpose?

Table 1. Experience dimensions.

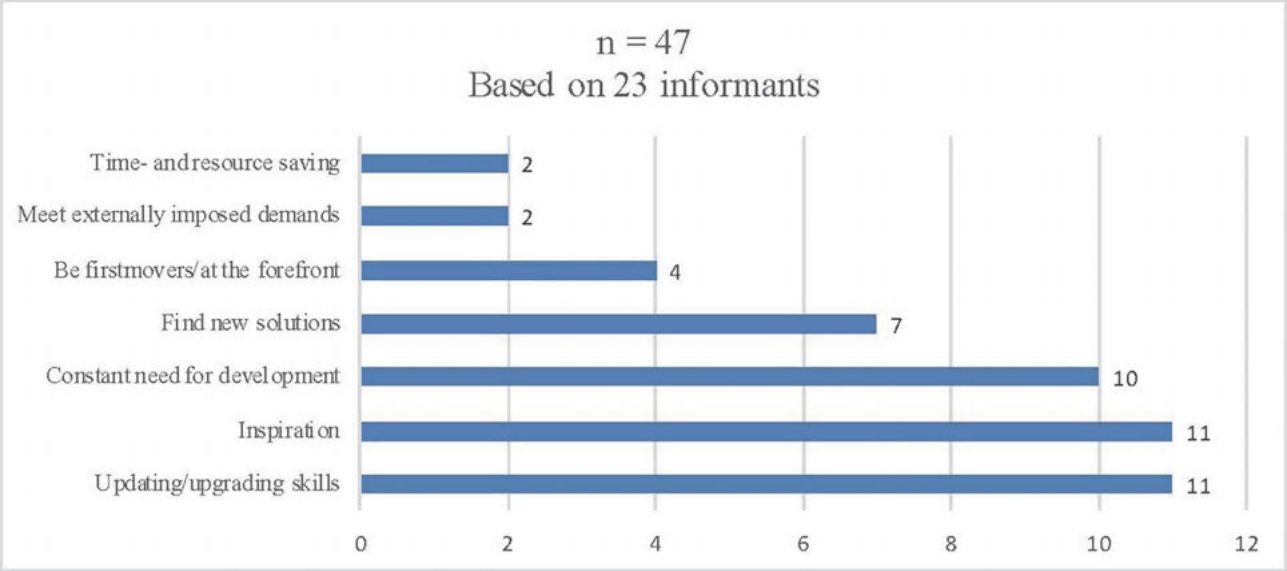

Figure 1. Reasons to find information.

searching is increased. Secondly, by involving the user as an active participant in knowledge transfer, this knowledge becomes palpable and tailored to the user's requirements. The relevance of searching is enhanced.

5.0 Findings about SMEs' information practices

The study was focused on getting an insight into "why," "where" and "how" SMEs seek information. Why do SMEs look for information, what channels are used by SMEs to look for information, and what challenges do they face when they look for information?

A clear pattern emerged as to what reasons SMEs had to find information. They did so predominantly in two situations. First, they looked for information when they had to solve a pressing problem or task, thus looking for precise information. Second, they looked for information when they did not work with a specific problem and their task was 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."

The SMEs used a variety of channels to gain information. Referring to "colleagues" was the most common way to acquire information, which implies that SMEs prefer to access information through personalised relational pathways. The mention of "external networks," "rival companies," and "experts" also pointed to this. Collectively, this indicates that employees in SMEs are accustomed to working closely together to solve problems, which is a conse-

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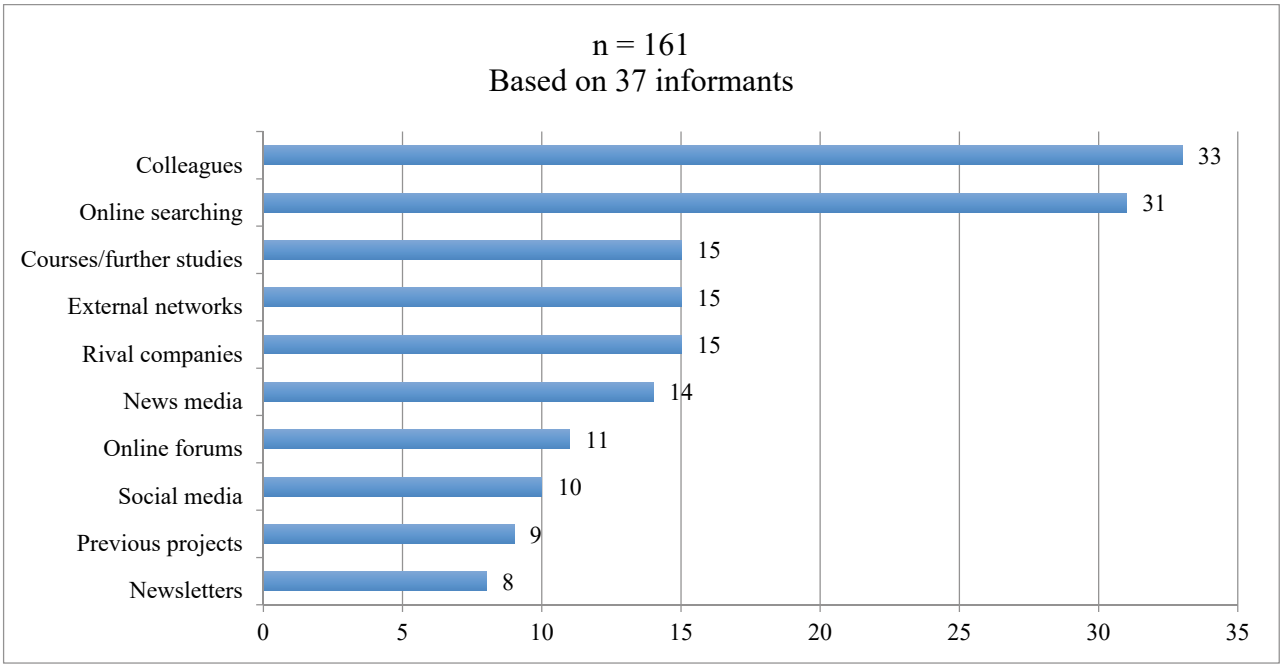

Figure 2. Channels to find information.

quence of the smaller number of employees in this type of enterprise. Further, 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.

The interviewees mentioned "online searching" to be almost as important as "colleagues," which implies that there was also a desire to look beyond the enterprise and internal information. 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 information. 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.

"Courses and further studies" also figured relatively highly, which indicates an orientation towards intensive training in a chosen and relevant subject. The employees' mentions of "rival companies" and "previous projects" both indicate a need for the information to be experience-based. The use of "online forums" and "social media"—by which the informants meant specific market- and business-oriented sites with news and chat functions—indicates an orientation towards ad-hoc knowledge that might provide new ideas and inspiration. The factor of "newsletters" is related to this. These mentions of digital information collectively describe a need for scientific knowledge to be present in cases where SMEs voluntarily engage in knowledge transfer.

SMEs face several challenges when they seek information. Figure 3 shows the barriers to information in general, whereas Figure 4 lines up the barriers related to scientific information in particular.

The reality of being busy and short on time was predominant in the responses about barriers to gaining information in general. This means that browsing for information without a specific goal in mind is often not an option; only when it is absolutely necessary can time be allocated to gaining information. This relates also to the factor of "expenses and resources." 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.

Other important challenges were that information can be "difficult to find and convert into something concrete;" that "too much material is available;" that it can be difficult to "know what it is you need to know;" and that attitudes of "we do as we are accustomed to doing" and "we know best ourselves"—together with an immediate understanding of "we do not need such knowledge"—were prevalent in relation to both information in general and scientific knowledge in particular. It would seem that an important task should be to show clearly to SMEs what type of scientic knowledge the university offers and how it relates to everyday problems and to exemplify how that knowledge can be converted into something concrete. Scientific knowledge must be described and communicated in a way that SMEs can see how they can gain from it; how the knowledge can be profitable has to be made immediately

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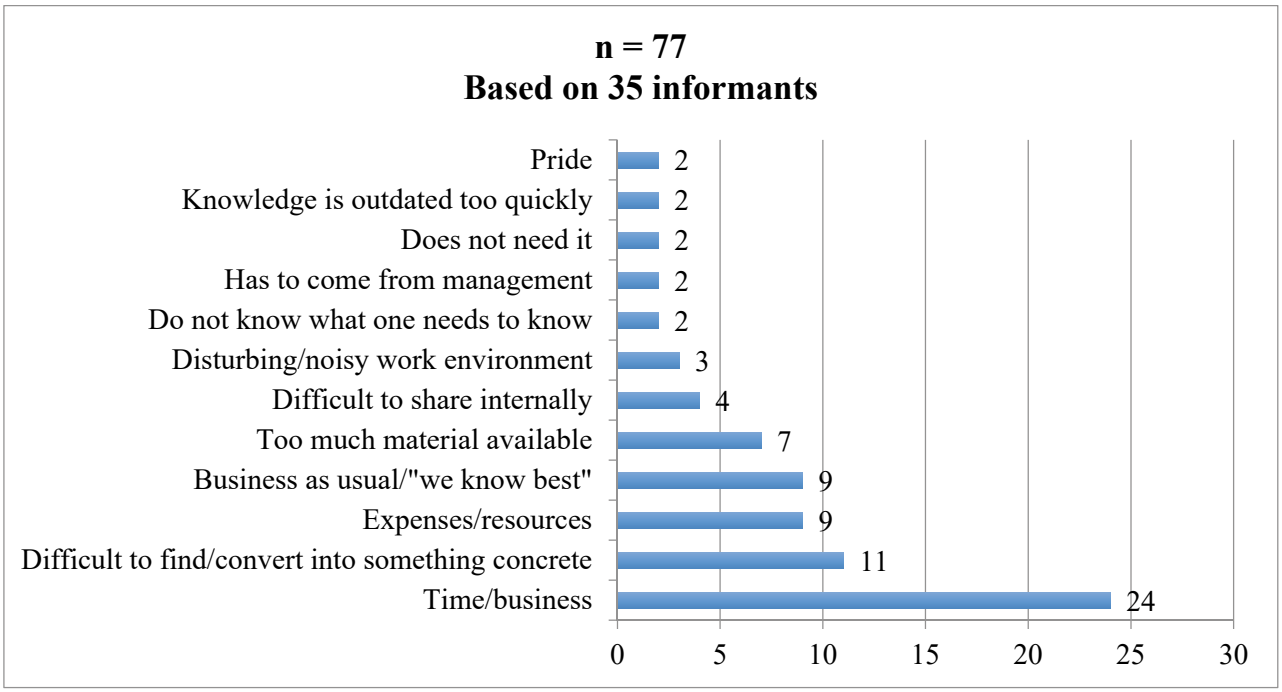

Figure 3. Barriers to information in general.

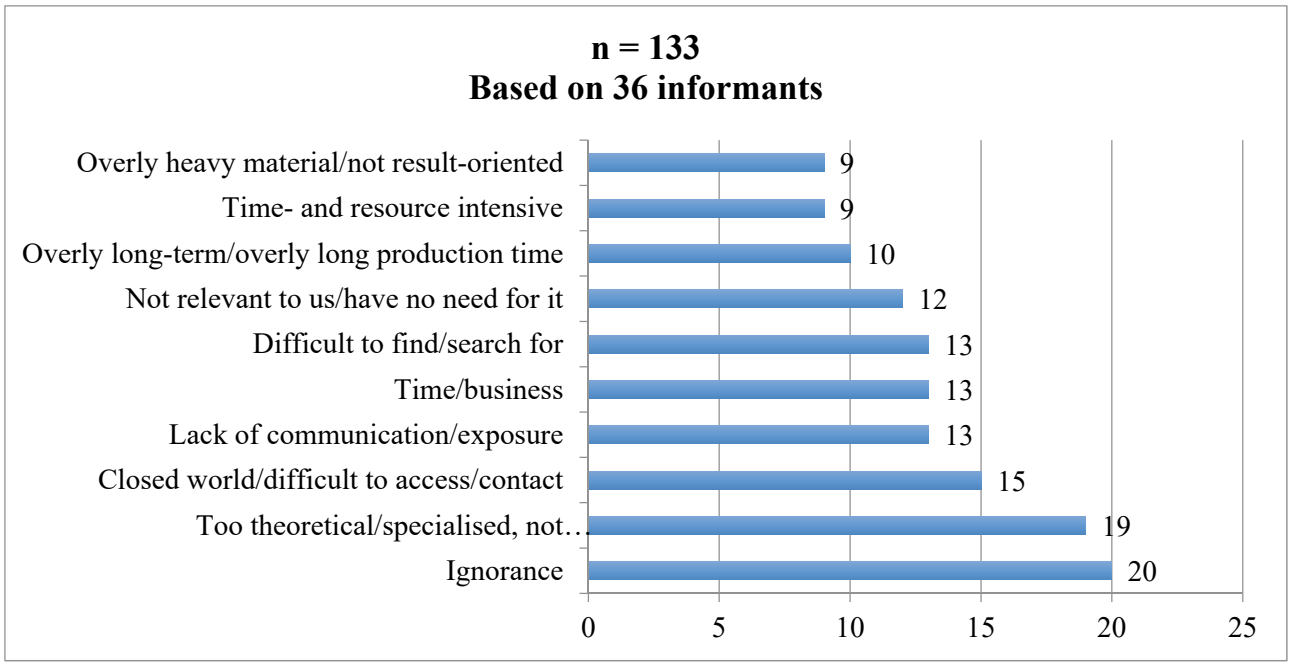

Figure 4. Barriers to scientific knowledge in particular.

obvious. In particular, the organisation and description must show SMEs what it is that they need to know. Understanding their working situations would equate to accepting that SMEs will not themselves be the proactive partners in SME–university relationships—they need the universities to take on this role.

The challenge the informants mentioned most frequently related to scientific knowledge in particular 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.

At the same time, we found evidence that the informants had an immediate understanding that scientific knowledge was "not relevant" or that SMEs "had no need

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for it." They also rated "lack of communication and exposure" relatively highly. Thus, universities must strive to be the proactive partner in these relationships and demonstrate to SMEs what universities do—and how that knowledge can be of value. A related problem was "difficulties in searching for scientific knowledge," which conveys the idea of what we mentioned earlier: that it is difficult to know what one needs to know and that the search for scientific knowledge is a real challenge if one does not know what the universities know (or what one could do with that knowledge even if it "is" known). As we discussed earlier, the SMEs we studied only allocated time for seeking information if that knowledge was related to the execution of a specific and urgent task.

The second-highest challenge was that the knowledge was "too theoretical and specialised and therefore not practicable." This is a problem related to the "characteristics" of scientific knowledge. Related to this is the problem the informants cited where "the material is overly heavy and not result-oriented." Universities must consider ways of transforming their knowledge into products that will meet the SMEs' list of criteria. Another considerable challenge the informants mentioned was "overly long production times." It is commonly accepted that SMEs generally work on a short-term basis, while universities do not (Alves et al. 2007; Ankrah et al. 2013). This often means that scientific knowledge remains beyond reach, since SMEs simply cannot wait for the knowledge to be produced and published.

To summarise these findings, the transfer of scientific knowledge between university and SMEs is largely a communication problem. The university must be proactive, promoting the scientific knowledge and showing its potential use and profit, thereby diminishing the SMEs' ignorance and mental barrier. The other very important challenge is to make scientific knowledge easily and quickly accessible. The SMEs do not have time for information searching. As a consequence, it should be very easy to access and use the pathway. As Star and Ruhleder (1996) describes it, the pathway should be embedded and integrated in the everyday, social structures of the SMEs. The scientific knowledge should be close to daily life; problem-oriented rather than theoretical, experience-based and specific (i.e., according to the business or market area). Access to scientific knowledge should be cost-effective and inexpensive (preferably free of charge). Online searching, colleagues and previous experience are channels that are consulted in situations involving pressing problems, whereas newsletters, social media, courses, new media, and rival companies are channels for inspiration and new ideas.

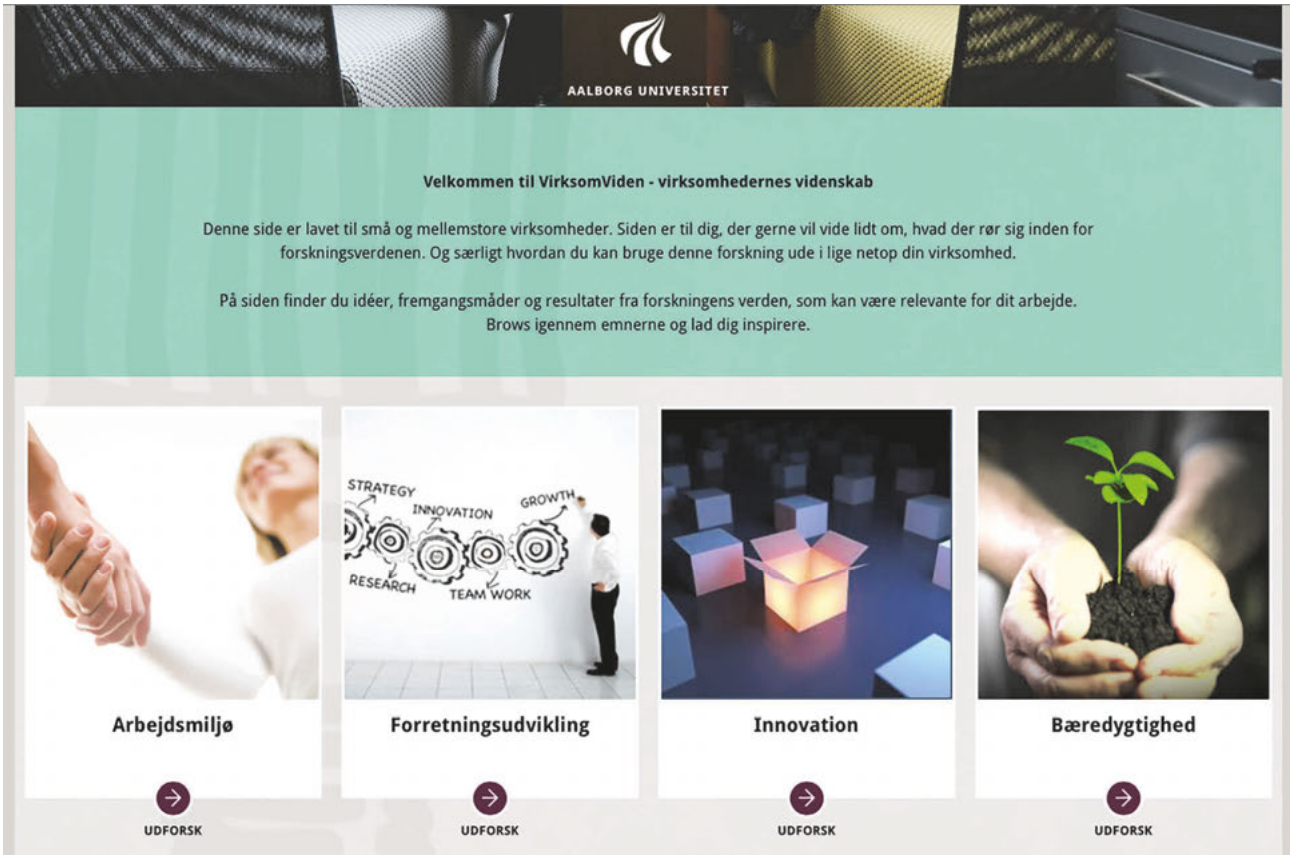

Figure 5. Organisation by everyday subject categories, randomly organised.

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The study has provided us with a nuanced insight into SMEs' ways of dealing with information. The findings allow us to identify some basic requirements for the knowledge organisation of a generic pathway to scientific publications. The study also confirmed our assumption that the classical design qualities for knowledge organisation systems seem not to be sufficient goals (Lancaster 1998). We present below how we have related the identified requirements to the experience design principles and used them to describe and organise the scientific knowledge in a way that it reflect the everyday situation and information practice of SMEs.

Based on the findings of our study, those experience dimensions related to the barriers that SMEs experience in their information seeking seem to be seminal to address in order to improve the knowledge transfer between universities and SMEs. The organisation of the scientific knowledge should therefore deal with those dimensions. The dimension "closeness" in a design addresses the barriers caused by the work context of information seeking by acknowledging the time constraints and other expenses involved in gaining information. By being "relevant," a design meets SMEs' needs for customized and commercially applicable knowledge and challenges the prejudice against scientific knowledge as being "not relevant." The "interesting" dimension counters the notion that the dissemination of scientific knowledge is too "specialized," too "technical or theoretical." The "involvement" dimension challenges the preconception that universities are a closed world difficult to access. "Spontaneity" furthermore generates curiosity about the latest scientific knowledge, whereas "interactivity" stresses that knowledge transfer is not only about transmitting but also about sharing knowledge. Our design thus focuses on these dimensions.

6.0 Suggestions for experience-oriented knowledge organisation

Knowledge organisation in websites is about presenting and organising content, allowing the user to get around, show context, describe usage and specificity, and relate to, e.g., other content, subjects, authors (Kalbach 2007). We will concentrate our discussion on how to meet the characteristics of SMEs in the design of navigational subject categories, controlled and uncontrolled keywords, and annotations.

6.1 Principles of closeness and spontaneity

> Organisation according to everyday tasks and to the identified information seeking behaviour. The purpose is to embed and integrate the knowledge into everyday practice.

We have organised the publications by subject categories reflecting everyday processes and functions that SMEs need to handle in order to run their companies, e.g., strategic development, innovation, work environment, sustainability, and marketing. Through this organisation, we seek to enable both focused access to knowledge that is related to everyday problems (the dimension "close") and unfocused browsing for new ideas (the dimension "spontaneous"). Every topic category is represented by a word in layman's terminology, a picture reflecting the task or problem to guide the user and a button "explore" that allows and encourages the user to immediately click and explore related scientific publications within the subject area. Each publication is presented through a title, controlled keywords, an annotation, and a picture or graphic.

The subject categories are unrelated and organised randomly, as opposed to more traditional forms of organisation (e.g., hierarchical or facetted). Findings from the workshops told us that users prefer easy, informal browsing that they are familiar with from Instagram and other social media platforms that allows them to scroll quickly through the content. The random organisation is close to the users' preferred seeking behaviour as well as spontaneous as it invites them to unplanned and playful or "paratelic" navigation.

6.2 Principle of involvement

> Multimodality in words, pictures, sounds, and navigation routes. The purpose is to allow the users to access scientific knowledge in different forms; to support easy and engaging access.

The study showed that the SMEs use a large variety of channels and knowledge types when looking for knowledge. The broad set of channels is the reason why, for each of the topic categories, we guide the users to other related channels, e.g., researcher profiles, video presentations by university researchers, information websites, e.g., websites from knowledge centres or government agencies, other video clips, e.g., TED talks, and scientific news media with articles about the topic, e.g., Videnskab.dk. The idea is to engage the users and allow them to get immersed so that they are willing to continue their journey through the interface.

The related channels are presented by a title, specific uncontrolled subject keywords and a controlled subject category for the channel type. The channel type subject categories and keywords are controlled with the purpose of making the users aware of the large variety of possible channels. The uncontrolled keywords are chosen with the goal to involve the users and guide them to new understandings.

Researcher profiles and researcher video presentations by university researchers are presented before the presentation of other related channels. We made this choice to

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promote scientific knowledge channels, but also to facilitate personalised knowledge transfer through university researchers, as we know from the findings that personal contact with colleagues was the most common way to acquire information. This is the reason why we chose to introduce and highlight the university profiles and video presentations, thereby guiding the SME staff to personal channels so that the SME staff are able to contact and interact with key university personnel. A click on the researcher's name will lead the user to detailed information about the researcher, e.g., CV, photos, press, etc., organised by controlled metadata and related keywords.

Similarly, a click on the scientific publications in the subject tab will lead the user to additional data about the publication, and in many cases, to open-access versions. The goal is to encourage the users to dig deeper into the knowledge base. In the specific prototype, this information is drawn automatically from the university research information management system.

6.3 Principles of interest and relevance

Surprising teasers (introductive annotations) to relevant result-oriented knowledge. The aim is to both catch the attention of the user and convince him or her that scientific knowledge is relevant and interesting.

The lack of communicative capability in the presentation of the scientific publications is among the most important challenges that we face in the transfer of scientific knowledge from universities to SMEs. SMEs generally find scientific knowledge vague and abstract, i.e., "not-relevant." From the SME perspective, researchers do not clearly convey what problems they are addressing or solving. It does not clearly present how SMEs might benefit from the scientific knowledge, how they can use it and why they need scientific knowledge.

The divergence in writing styles and language use is maybe the largest challenge for the generic pathway that has not built in the possibility of dialogue and collaboration. Scientific information is therefore often regarded as "not-interesting." The challenge is multifaceted. The first step is visibility in order to draw attention and interest to the scientific knowledge. The next step is demonstrating and convincing the SME user that he may have a problem that can be helped by scientific knowledge; that the scientific knowledge may provide useful, relevant solutions. Thereafter, the task is to present the knowledge and results in such a form that the SME user can see that the knowledge is addressing and providing answers to everyday problems so as to communicate the knowledge at a sufficiently concrete level and in an understandable language and style, i.e., the learning dimension. Perhaps the most important aspect is to communicate

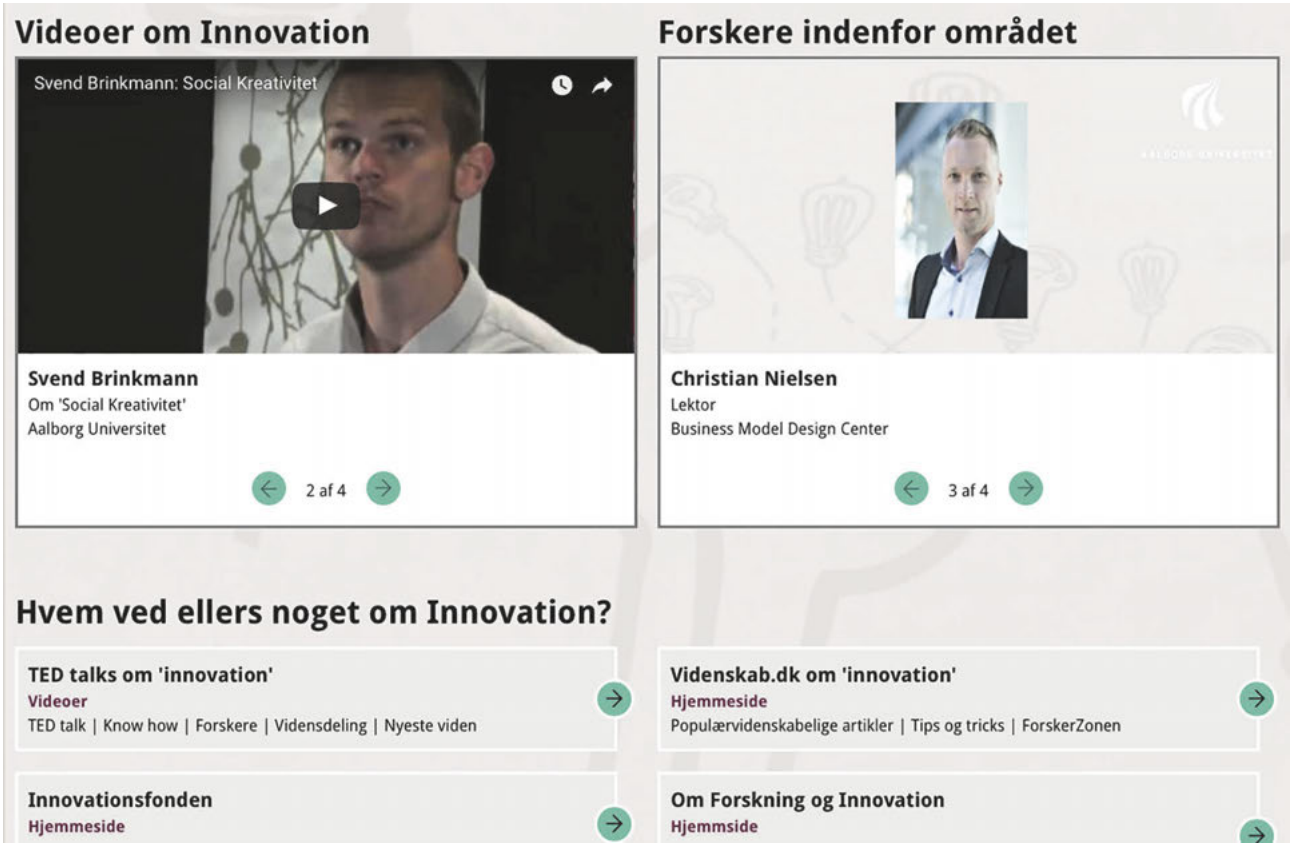

Figure 6. Multimodal, spontaneous navigation to related channels and forms of knowledge.

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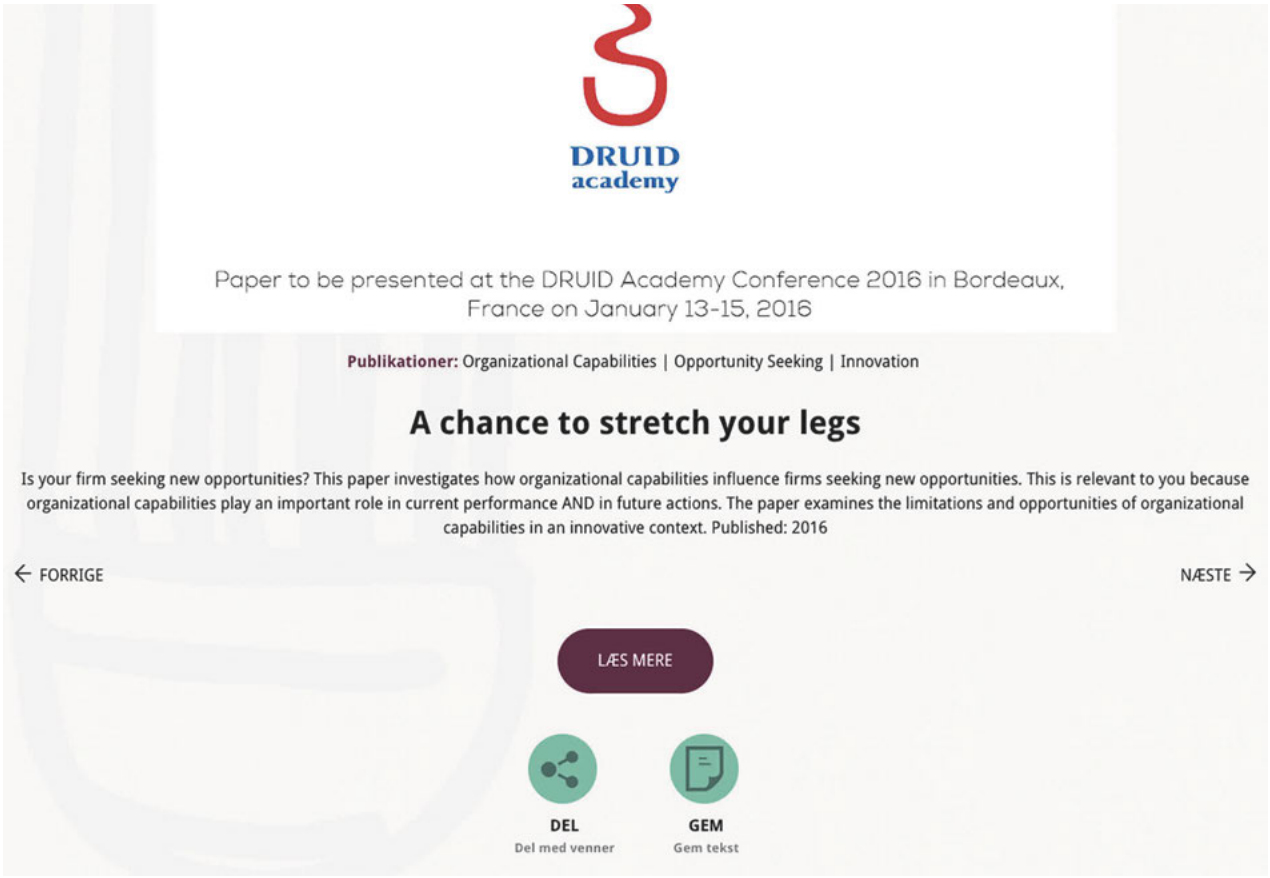

Figure 7. Relevant, interesting, result-oriented teasers.

the information in an involving and interesting form and style so that the SMEs will take the time to read it and interact with the knowledge.

We have worked with this communicative challenge in the formulation of all types of textual communication: subject categories, annotations, keywords, and meta-communicative texts (introduction, headlines, and explanations). The overall aim was concreteness and result-orientation in the communication of scientific contributions (the dimension of relevance). Another important aim was to catch the interest of the user (the dimension of interest). We use several communicative approaches to obtain this combination of concrete, precise descriptions and eye-catching, interesting presentations.

We start the annotations by a "teaser in the teaser," formulated as a kind of discovery. The idea is to attract the attention of the user, involve and convince him/her, e.g., by a question and a short answer as to why this is interesting and relevant knowledge; see, e.g., the following annotation:

> How can we measure and evaluate initiatives in the work environment? Demands for documentation and legitimation are increasing. The effect of work-environment initiatives must be visible. This may be difficult, as work-environment problems are complex.

We continue the description with a presentation of the knowledge conveyed by the publication:

> The paper presents a diverse set of approaches to the evaluation of work-environment initiatives: process evaluation, monitoring, effect evaluation, and efficacy evaluation.

We end the presentation with an explanation of how the SME can use the knowledge in everyday work and problem solving—a pointer to learning and concrete use:

> By reading this paper, you will get the help you need to design an evaluation that is useful for your specific work environment.

6.4 Principle of interactivity

> Possibilities to save and share knowledge.

The main functions (things to do) are browsing by subject categories (subject and channel categories), free-text searching, and navigation to and between related channels. Additional functions are the possibility of saving scientific publi-

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cations for later use and of sharing scientific publications with colleagues and other collaborators.

During the study, many of the employees expressed how a lack of procedures (including a lack of time for knowledge sharing) was a significant challenge for knowledge transfer. This problem was repeated again during the workshops. Our solution consists of two actions: one for sending a link to a selected scientific publication to one's own email (the saving function) and another to send a link to selected publications to collaborators (the sharing function). In the present prototype, the link guides the user to the full description in the university research information management system.

Our solution is simple as the function, for example, does not allow the user to create a personal library or to add any information, e.g., additional uncontrolled keywords (user tags). We chose the simple solution, because the SMEs clearly expressed during the situational analysis and again during the workshops that they would not be motivated by any personal registration of the knowledge as they would probably never go back to already retrieved information but would always start up again with a new search or by a new browsing session.

7.0 Conclusion

Transferring knowledge from university to industry is difficult to accomplish, especially to small and medium-sized enterprises (SMEs) that have limited resources for in-house research and development (R&D). A range of channels is used for knowledge transfer; these include generic pathways that accommodate knowledge transfer through, e.g., patenting and scientific publications. SMEs use generic channels in the form of scientific publications, but the absorption of scientific knowledge is difficult. The research extends our knowledge about generic knowledge transfer of scientific knowledge, specifically about the knowledge organisation for a pathway between universities and SMEs of published, online research.

We investigated the information practice among SMEs through an empirical study, with the aim to relate this to previous findings and use this insight to develop design suggestions. The study provided a detailed insight into SMEs' ways and challenges. Generally, the SMEs look for knowledge in two situations; when they have pressing problems to solve and when they seek inspiration for new business opportunities. The SMEs consult many different channels in order to find the needed knowledge, and the scientific knowledge from universities is not their first choice. SMEs do not have much (any) time for information searching. The access to scientific knowledge should be embedded in the daily work tasks; a ready at hand task. SMEs see scientific knowledge as abstract and theoretical. From the perspective of SMEs, scientific publications do not inform clearly what problems they address or solve. They do not present how SMEs can gain from the scientific knowledge, how they can use it, and why they need scientific knowledge.

We related the identified requirements to the ten experience dimensions that have been developed to inform experiential design. Based on the analysis we found that six of the dimensions were especially important to address in the design of the knowledge organization and interface for the generic pathway. They concern aspects related to the barriers that SMEs experience in their information seeking. Improving such aspects is thus seminal for strengthening the knowledge transfer between universities and SMEs.

Key qualities for the knowledge organisation is closeness, relevance, interest, involvement, spontaneity, and interactivity. The design suggestions include simple, straightforward navigation by a one-level, randomly organised set of subject categories to multimodal scientific knowledge. The knowledge organisation allows the user quickly to browse through subject categories to find solutions for specific problems or to navigate spontaneously to become inspired. Concrete subject categories and annotations close to everyday tasks are essential to provide understanding for the content, what is key knowledge, why it is useful, and how to use it. We suggest "teasers in the teaser," to catch the attention, generate curiosity, involve, and convince the SME-user that scientific knowledge is useful. Not hip teasers, but precise, concrete information related to everyday concerns about what, why, and how scientific publications may solve problems and may help developing the enterprise.

Overall, the study confirmed previous research that SMEs deserve special attention in the presentation and organisation of knowledge. They are interested and willing to use published research, but they find the scientific knowledge difficult to find, theoretical and abstract, and hard to implement in daily problem solving. We applied the theoretical mind-set of experience design with the aim to design a knowledge organisation system that draws attention to scientific knowledge in a potentially surprising and inviting way that is closely related to everyday practice. We experienced a good match between the requirements of the SMEs and the qualities that experience design offers. We transformed the experience design criteria to design principles of knowledge organization and interface design.

Our main contribution is thus firstly to interpret common SME queries concerning research contributions in terms of a low or modest degree of "experientiability" of these publications, and secondly to use experience dimensions as guidelines for knowledge organisation design principles that may increase the "experientiability" of research contributions for SMEs. Organizing knowledge in accordance with experience design principles helped us to develop and organise subject categories that motivate users

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to initiate, prolong and repeat their search activities, firstly, because searching becomes engaging with subject categories that are relevant, close to everyday work as well as interesting. Secondly, the scientific knowledge became palpable and tailored to users' absorptive capacity by teasers and an involving and interesting form and style including multimodal modes of presentation. Thirdly, the organisation is involving by encouraging the user as an active participant in knowledge transfer.

The next step is to evaluate whether the SMEs indeed feel invited, involved, and informed—and whether they are willing and able to include the pathway as an integrated part of their daily work tasks.

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