The organization of innovation projects within professional service firms

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INTRODUCTION

Over the past few years there has been a growing interest in professional service firms (PSFs) among researchers (Empson, 2001; Greenwood et al., 2006; Hinings & Leblebici, 2003; von Nordenflycht, 2010). PSFs have become of interest for multiple reasons. One research stream focuses on PSFs because of their growing sector within the economy (Delong & Nanda, 2003). Aharoni (1993a) researched the growth of PSFs compared to other businesses between 1978-1986 in the Unites States. The results showed an increase in employment within PSFs of 53.8 percent compared to 13.1 percent in the rest of the economy (Aharoni, 1993a). The global revenue of the professional services industry was estimated to be $700 billion (Scott, 1998). Three years later this figure had grown to $911 billion (Lorsch & Tierney, 2002). Another stream studies the factors which lead to new service success (Avlontis et al., 2001) and the distinctive theories of management needed for this success (von Nordenflycht, 2010). Greenwood et al. (2005) suggest the ability to manage knowledge is critical to a PSFs success which demands distinctive theories of management. Many researchers are also interested in PSFs because of their high knowledge intensity, which makes them useable as models for an increasingly knowledge-based economy (Empson, 2007; Gardner et al., 2008; Gilson & Mnookin, 1989; Greenwood et al., 2006; Hinings & Leblebici, 2003; Løwendahl, 2000; Maister, 1982; Scott, 1988; Teece, 2003; Winch & Schneider, 1993).

Innovation is widely recognized as an important source of competitive advantage within ever changing environments (Dess & Picken, 2000; Tushman & O'Reilly, 1996; Lam, 2010). Management scholars regard innovation capability to be the most important determinant of firm performance (Mone et al., 1998). Schilling (2005) states that innovation has become increasingly important over the years due to the globalization of markets and the advances in information technology.

Professional service firms and innovation have thus been increasingly important over the last few years. However, there is little research on innovation within services (Sundbo, 1997; Crozier et al., 1982). The organization of innovation processes within PSFs is a new topic within the field of innovation (Sundbo, 1997). Avlonitis et al. (2001) state that product innovativeness is almost entirely neglected in the development process and performance of new services. Anand et al. (2007) refer to the almost non-existing research on the organizational structure of PSFs to explore and exploit new forms of knowledge. A firm's ability to effectively explore and exploit new knowledge is critical for innovation (Levinthal & March 1993, March 1991). Other researchers state that the incremental and continuous nature of most innovations in PSFs is the reason for little academic research (Malhotra, 2016). In contrast, non-service industries are more studied because of their radical and discontinuous innovative nature (Gupta et al.,2006).

Within academic literature there are no clear models which describe the organization of innovation projects within PSFs. Some models and theories are mentioned but these are mostly based on existing models from product innovation research and literature on the manufacturing industry. It can be questioned whether these two highly diverse industries can be compared. Thus far, there remains a considerable amount of ambiguity about how

innovation processes are organized and managed within PSFs. Therefore the purpose of this study is to research the following question:

How are innovation projects organized within professional service firms?

This paper will try to answer this question by researching the organization of innovation projects within a specific type of professional service firms, a hospital. More precisely, the unit of analysis will be an academic medical center. This paper is organized as follows: first, the theoretical background is discussed. This is followed by the methods section. Hereafter, the results will be presented. This section is divided into three main parts: the general organization of innovation projects in PSFs**,** results from the cases (success factors and experienced difficulties) and the advice plan. Finally, there will be a discussion.

THEORETICAL BACKGROUND

Professional service firms

There remains ambiguity over the exact definition of professional service firms. Von Nordenflycht (2010), states that within many studies on PSFs, the term is only partially defined or not defined at all. He claims that the ambiguity of the definition hinders research on PSFs in a number of ways. First, most researchers focus their research on firms which are certainly professional services. Therefore empirical research focuses extensively on canonical industries (e.g. consulting, law). Second, since the term cannot be clearly defined, existing tests on how PSFs are distinctive cannot be carried out. Most studies on PSFs focus on one specific industry, there is hardly any research which compares different professional services (Von Nordenflycht, 2010). It remains difficult to say whether theories developed while studying consultancy firms can also be applied to other PSFs (e.g. law firms, hospitals or R&D agencies). Von Nordenflycht (2010) attempted to define PSFs based on three distinctive characteristics often associated with PSFs - knowledge intensity, low capital intensity and professionalized workforce – and their managerial implications.

Knowledge intensity can be seen as the most fundamental characteristic of PSFs. It signifies that a firm's production output depends on a significant body of complex knowledge (Starbuck, 1992; Winch & Schneider, 1993). It is important to note that in the case of PSFs, knowledge intensity refers to knowledge embodied in individuals (Alvesson, 2000) as opposed to knowledge embedded in non-human attributes (e.g. products and routines). Managerial implications resulting from knowledge intensity are described as: cat herding and opaque quality. The first refers to the difficulty of retaining and directing highly skilled employees. Because of their substantial human capital, their skills are scarce, which gives them a strong bargaining power (Teece, 2003). Other scholars argue that these employees are difficult to direct because of their preference for autonomy and aversion for supervision, direction and formal organizational processes (DeLong & Nanda, 2003; Greenwood & Empson, 2003; Lorsch & Tierney, 2002; Starbuck, 1992; Winch & Schneider, 1993). Because of these reasons managing knowledge-intensive firms is often referred to as "herding cats" (Løwendahl 2000). The second implication, opaque quality, refers to situations where the output of the experts is difficult to evaluate for non-experts (Empson, 2001; Levin & Tadelis, 2005; Løwendahl et al., 2001). This results in implications for the need of mechanisms that

indicate quality. This can be done through bonding mechanisms, reputation, appearance and ethical codes.

The second characteristic is low capital intensity which suggests that a firm's production does not involve a high amount of (intangible) nonhuman assets (e.g. inventory, factories, patents). This characteristic is less fundamental than knowledge intensity since PSFs can have significant nonhuman assets. Hospitals would be the perfect example of PSFs which have high knowledge intensity but also high capital intensity.

Professional workforce is the last characteristic. A profession can be defined based on three key features. First, a profession involves a particular knowledge base. Second, a profession has an ideology based on norms and ethical codes which are enforced by professional associations (Leicht & Lyman, 2006). Third, professions are self-regulatory meaning that it has a monopoly on the use of knowledge.

Von Nordenflycht (2010) decided that based on these three characteristics it remains difficult to provide a sole definition of PSFs. Some firms which are clearly PSFs do not possess all of the characteristics. He therefore made a taxonomy of four different categories of PSFs. Firms that match all three characteristics have the highest degree of professional service intensity and are named *Classical PSFs*. The second category consists of firms that are more capital intensive (such as hospitals) and are labeled *Professional Campuses*. Firms that have non-professionalized workforces but confirm to the other characteristics are called *Neo-PSFs* (e.g. management consultancies). The last category displays the lowest level of professional service intensity but does experience problems such as opaque quality and cat herding. They are labelled *Technology Developers* (e.g. firms who are composed of scientists).

Innovation and service innovation

Innovation has been around for centuries. Before 1915, innovations were mostly developed by the lone inventor, innovators who individually came up with creative projects and formed to companies to further develop their ideas (Anthony, 2012). Most innovations were thus identified by their initiator (e.g. the light bulb by Edison). Later on as the importance of the assembly line grew and innovation became more complex and expensive, innovations became more company based. Companies shifted from exploiting innovations to becoming innovation creators where the first R&D labs were set up and experimentation was supported (Anthony, 2012). During the 1980s and 1990s companies started to experience dilemmas in product innovation. Companies experienced an increasing demand for new products but innovation was still a high risk factor which was full of difficulties and failures (Cooper & Kleinschmidt, 1987). Within this era, the importance of innovation management started to grow significantly.

In the 1920s, Schumpeter proposed the first definition of innovation (Hansen & Wakonen, 1997). He defined innovation as: *a new good or a new quality of a good; a new method of production; a new market; a new source of supply; or a new organizational structure, which can be summarized as 'doing things differently'*. Schumpeter mainly focused on the novelty aspect of innovation. Crossan & Apaydin (2010), proposed a more complete definition of

innovation: *the production or adoption, assimilation, and exploitation of a value-added novelty in economic and social spheres; renewal and enlargement of products, services, and markets; development of new methods of production; and establishment of new management systems. It is both a process and an outcome (p. 1155).* As can be seen in this definition, innovation can have multiple forms. It can be products, services, markets, business models and so on. Literature on innovation frequently mentions that competitive success depends on a firm's capability to effectively manage innovation processes (Cooper 1979a,b; de Brentani 1991; Di Benedetto 1996; Ernst 2002; Globe et al. 1973; Griffin 1997; Rothwell et al.,1974).

The main difference between product and service innovation relates to the nature of services. Services are mostly intangible where products are tangible. The intangibility of services changes the development process of such offerings (e.g. the testing phase is more difficult) (Avlonitis, 2001).

Studies on new service development (NSD) are scarce (Alam & Perry, 2002) Avlonitis et al. (2001) researched the role of product innovativeness within NSD and performance. They specifically chose the service sector since previous research only focused on the role of manufactured products. They came up with five stages of new service development: (1) idea generation, (2) business analysis and marketing strategy, (3) technological development, (4) testing, and (5) launching (Avlonitis et al., 2001). These stages were developed based on new product development (NPD) activities being adapted to a service context. The resemblance to the stages of Cooper's (1990) stage gate model are significant.

Three distinct perspectives of literature on NPD and NSD can be found. Advocates of the "assimilation approach" argue that concepts developed in a manufacturing context can be easily applied within a service context because of the existing similarities (Nijssen et al., 2006; Coombs & Miles, 2000). The four main similarities between successful NSD and NPD are the following. First, they display high management involvement (Nijssen et al., 2006). Second, their culture and systems are aligned to the innovation processes (Johne & Storey, 1998). Third, their NSD and NPD processes are structured and formalized (Johne, 1993). Last, their innovation projects are complemented by high quality development staff and resources (Johne 1993; Johne & Storey 1998).

Proponents of the "demarcation approach" disagree and put emphasis on the unique characteristics of services and therefore the need for new concepts and models designed specifically for services (Coombs & Miles, 2000). These differences are mainly due to the specific characteristics of services (e.g. intangibility and heterogeneity). These differences make NSD projects more unique because of several reasons. First, there is a higher relationship between new service development and service delivery. Or as Edvardsson & Olsson (1996) state: *"it is not the service itself that is produced but the pre-requisites for the service" (p. 1476).* Second, compared to NPD it is more important that the new service matches the existing system (Nijssen, et al., 2006). Third, R&D expenditures are lower for service innovation than manufacturing innovations (Barras, 1986; Brouwer & Kleinknecht, 1996).

The third perspective is referred to as the synthesis approach and is the most recent within academic literature (Drejer, 2004). This approach suggests that there are blurring boundaries between services and manufacturing and that thus far disregarded elements of service

innovations can be applied to a manufacturing setting (Coombs & Miles, 2000; Preissl, 2000; Drejer, 2004).

Innovation within PSFs

Academic literature on innovation mostly focuses on innovations developed by firms. However, in some cases innovation projects are initiated by firm employees. Within PSFs, innovation is generally embedded in the daily work of its employees (Anand et al., 2007; Heusinkveld & Benders, 2005; Mom et al., 2007). Clients expect customized solutions to their problems, therefore these solutions are often innovated by front line employees (Malhotra et al., 2016). Dougherty (2004) also notes this and argues that knowledge-based innovations arise from ongoing work after which they get embodied into organizational structures. Anand et al. (2007) state that PSFs are thus highly reliant on their staff for gaining a competitive advantage through knowledge-based innovation. Within academic literature there are some fields which focus on the initiation of innovation projects by employees or importance of a bottom-up approach. The fields discussed here are the lone inventor, intra- and entrepreneurship and strategic recognition.

*Intra- and entrepreneurship***.** Hellmann (2007) states that the most important sources of entrepreneurship are employees of established firms. He argues that employees can obtain new ideas which are unrelated or not part of their current job description. These employees would then have to decide whether to pursue the exploration of the new idea or ignore it and maintain performing their original task. The firm needs to make a managerial trade-off as to (1) decide to encourage the exploration of new ideas by its employees or (2) to pursue exploitation of its employees by letting them focus on their core tasks. For this research only the first point is of importance to be further explained. Hellmann (2007) implies that there are two possible equilibrium outcomes when the firm decides to encourage employees to pursue exploration. The first outcome is that the employee leaves the firm and becomes an entrepreneur. In the second equilibrium outcome the employee stays and develops her innovations internally, which turns the employee into an intrapreneur. This is the case when the employee holds the intellectual property (IP) of her innovation. When the IP belongs to the firm, the innovations are used to found spin-offs or they are shelved (i.e. not further developed).

Intrapreneurship refers to the entrepreneurial activities of employees conducted within an existing organization (Gündoğdu, 2012). The study of intrapreneurship has been expanding over the last 30 years (Sathe, 2003). Pinchot (1985) defines intrapreneurship as *"those who take the hands-on responsibility for creating innovation of any kind within an organization"* or *"dreamers who do"*. Pearce & Carland (1996), emphasize creativity and/or innovation as the focus of intrapreneurship and define intrapreneurs as innovators and idea generators. They state that the outcomes of these innovations can be in terms of new products, services, markets and processes.

In order to make use of the creative ideas of its employees, managers need to be able to capture it, apply it to relevant opportunities and problems and ultimately convert this into valuable innovations (Fairbank & Williams, 2001). This is closely related to literature on absorptive capacity which is referred to as the ability of a firm to recognize the value of new information, assimilate it, and apply it to commercial ends (Cohen & Levinthal, 1990).

Managers need to have the absorptive capacity to see the potential of the creative ideas of its employees. Creativity is a basic human capability (de Bono, 1970), indicating that every employee has the ability to be creative (Fairbank & Williams, 2001). Unfortunately, absorptive capacity is a key challenge in today's management practices (Hamel, 2000; Hitt, et al. 2000). Basadur (1992) even states that although western businesses are famous for their innumerous innovations, they are also well-known for their inefficiency to systematically utilize creative ideas of employees. There are two main reasons as to why this occurs. First, the cognitive limitations of managers inhibits them from objectively considering the potential creative ideas of their employees (Fairbank & Williams, 2001). This is due to the business structure some companies adhere to which limit information overload in order to improve effective decision making (Simon, 1957). Second, the mechanistic organizational structures many businesses have require adherence to current operating procedures, which does not allow for experimentation with new methods (Burns & Stalker, 1961).

Lone inventor. The lone inventor, also referred to as independent inventor is a creative isolated individual who mostly does not work in a team and/or does not work for an organization (Singh & Fleming, 2010). Within literature, they are praised for their invention of breakthrough innovations (Schumpeter 1934; Hughes, 2004; Dahlin et al., 2004). A reason for this is that they have more stimulus to tackle dominant design models in new ways because they do not have to deal with older product generations and they are not as devoted to industry problem-solving methodologies as corporate inventors (Schumpeter, 1934; Reinganum, 1983, Henderson & Clark, 1990). Åstebro (1998) found that inventions from lone inventors are at lower cost than similar inventors employed at large corporations. In fact, their development costs are about one-twelfth compared to those of established firms (Åstebro, 1998). Lone inventors can thus be seen as great sources of inventions and innovations. However, there is one major constraint to this success. Lone inventors are found to have a low commercialization rate compared to corporate inventors (Åstebro, 1998; Holbrook et al., 2000). Åstebro (1998) found that lone inventors are only 17-25% as likely to commercialize their inventions as corporate inventors. Holbrook et al. (2000), state that it has been a key issue in entrepreneurship on how to best support lone inventors in their efforts to commercialization.

Strategic recognition. This last section discusses the importance of a bottom-up approach for PSFs. Companies within dynamic industries find it difficult to effectively align the firm's strategic intent and its strategic action. This difference between strategic intent and action is referred to as strategic dissonance (Burgelman & Grove, 1996). Burgelman & Grove (1996) propose that top management's ability to take advantage of conflicting information caused by strategic dissonance is highly important and that new strategic intent should be based on this ability. Strategic dissonance signals when development reaches a strategic inflection point (SIP), this point can represent a change in strategic intent of which a firm can take advantage of new industry conditions. If a firms chooses not to adapt the firm can fall into the valley of death. When a firm chooses to adapt to the new industry conditions a firm can bridge the valley of death and select the winning strategy. In order to effectively manage strategic dissonance and the SIP, "strategic recognition" is required. Strategic recognition is the capacity of top management to appreciate the strategic importance of managerial initiatives (Burgelman & Grove, 1996). Burgelman & Grove (1996) stress the importance of listening to

representatives from all levels of the organization since they can provide different insights on strategic issues.

METHODS

As mentioned in the introduction, the unit of analysis of this paper are academic medical centers. Due to time constraints one academic medical center was selected for research, namely the University Medical Center Groningen (UMCG). Therefore within this study, only innovation projects of the UMCG will be researched. This study can be regarded as a combination of theory development and academic problem solving. For the academic world this study provides insights into the organization of innovation projects within professional service firms. The academic problem solving aspect of this study focuses on an advice plan for the UMCG to better organize innovation projects. Academic literature thus far does not provide any information or solutions on this specific business problem. The structure of this study will follow the format of sub-assignments and deliverables presented by Aken et al. (2012). First, the business problem is characterized and validated. After this the most important causes and consequences of the problem are analyzed and diagnosed from various relevant perspectives. Hereafter, a potential solution is explored which will be transformed into a solution design. Finally, an advice plan is presented.

The University Medical Center Groningen (UMCG) - located in the city of Groningen - is one of the largest hospitals in the Netherlands as well as the largest employer of the northern part of the Netherlands. The UMCG employs over 10,000 employees (UMCG, 2017). It focuses on three specific core tasks, namely patient care, education and research. The mission of the UMCG is to build the future of healthcare, patient care, science and research, education and subsequent education (Mission and Vision UMCG, 2017). One of their key points of interest is to be pioneers in research. Through research, new knowledge is gained on healthcare, diseases, treatment and prevention. *"We use this knowledge for innovations: the practical improvement of care"*(Mission and Vision UMCG, 2017).

University hospitals place the perfect setting for upcoming innovations since they contain elements of both the higher education system and research, as well as of the healthcare system (Weigel, 2011). Often employees of the UMCG recognize a problem or notice areas of improvement in their work environment and come up with creative ideas for innovations. Within this paper these employees will be referred to as healthcare professionals: employees who are experts in a certain area of healthcare and look at problems from real life practices and/or from science. The profession of these healthcare professionals ranges from physicians, researchers, PhD candidates, medical specialists, associate professors, etcetera. Healthcare professionals are often intrinsically motivated to improve their field of business and therefore initiate innovation projects. Lettl et al. (2006) state that medical doctors who contribute to innovations as users have a high motivation for discovering a new solution, and therefore play a role as an entrepreneur.

However, like many other organizations the UMCG seems to struggle with the intrapreneurial activities of its employees. It lacks the absorptive capacity needed to evaluate the creative ideas of its employees. The problem arises in successfully developing these

innovation projects and commercializing them. A few innovation projects of healthcare professionals have already been successfully developed. Unfortunately, a number of projects that have been started face difficulties along the way and stagnate at some point in time of the innovation development process. Healthcare professionals have a significant amount of knowledge concerning healthcare and research, but often have little knowledge concerning the business side of an innovation project. Therefore, the academic problem solving part of this research focuses on finding out what the successes and pitfalls are of the innovation projects initiated by healthcare professionals and how the UMCG can better support this.

Sample

This study follows a multiple-case research design, which allows for a "replication" logic (Yin, 1984), in which the selected cases are treated as a series of independent experiments that confirm or disconfirm emerging conceptual insights (Brown & Eisenhardt, 1987). Eventually, seven cases were selected for research. Each case describes a different innovation project initiated by a healthcare professional of the UMCG. Table 1 in the appendix provides an overview of the general descriptions of the cases. The cases were selected based on theoretical sampling. According to Eisenhardt (1989) it is for case studies more preferable to select cases theoretically (as opposed to statistical sampling) in order to fill theoretical categories and provide examples of polar types. The cases were selected based on diversity of the background of initiators, different innovation types/products and diversity in whether they were already developed, implemented or still in development. Due to privacy reasons the cases are named case 1 – 7.

Data collection

The primary source of data was collected through semi-structured interviews with the initiators of the innovation projects. For some cases multiple persons were interviewed. Unfortunately, this was not possible for all cases due to time constraints. All interviews were held by the author of this paper. In total nine interviews were held with initiators of innovation projects. In order to sufficiently prepare for the interview I familiarized myself with the healthcare professionals medical specialty and innovation project. This was done through Internet research and reading up using generally accessible information. The interviews ranged from one to one and half hours. All the interviews were recorded and transcribed afterwards. After each case interview, the results were being discussed with my supervisor and emerging patterns were noted. The secondary source of data were observations, conversations and interviews (two more) with other employees who were involved with innovation projects and Internet data.

Data analysis

As Eisenhardt (1989) suggests the data was analyzed by first building individual cases and after this comparing these cases to construct a conceptual framework. First, all the interviews were transcribed shortly after the interviews were held. In order to avoid confusion it was chosen to focus on one or maximum two cases per week. Next, the transcribed interviews were analyzed and the successes and experienced difficulties were reported. After all of the individual case studies were completed, a cross-case analysis was used in order to develop conceptual insights. The cases were compared to identify the unique aspects per case and

more importantly to identify common successes and experienced problems. The data analysis process led to the following insights.

RESULTS

This study focuses on a number of questions regarding the organization of innovation projects by PSFs. For the case study these are: how are innovation projects initiated by healthcare professionals currently developed within the UMCG? What are the successes of these projects? What are the difficulties experienced by the healthcare professionals? And, what can be improved to provide better guidance for healthcare professionals initiating innovation projects? Within this results section a general description of the organization of innovation projects within PSFs is provided first. Next the success factors are being discussed followed by the experienced difficulties. Table 2 in the appendix contains an overview of all the success factors and experienced difficulties per case. An X indicates that the success factors/difficulties were experienced by the project, N/A means that it is not applicable to that case. Hereafter, the advice plan for a new central innovation hub is explained, followed by a suggestion for implementation.

General description

Few literature exists about the organization of innovations within professional service firms. This section will provide a general description of how innovation projects are managed within another type of PSF. This is based on the article by Sundbo (1997), who performed a study on 21 PSFs ranging from financial service firms, consultancy firms to manual services (catering firms). These firms differed significantly in the organization of innovation projects, therefore he divided the cases into three separate groups: top strategic organizations, network organizations and professional organizations (Sundbo, 1997). Due to the length of this paper only the management of innovation projects of top strategic organizations will be discussed.

The selection of innovation projects was mostly based on the strategic situation of the firm. Four of the eleven companies within this group had an innovation department, none of them had an R&D department. The main role of the innovation department was to encourage ideas throughout the organization and accumulate them. On average, four distinctive phases were observed in the management of innovation projects:

- *Idea generation:* intrapreneurship plays a significant role in this phase. One or more individuals came up with ideas from their everyday work, other service firms or newspapers.
- *Transformation into innovation projects:* the initiator tries to convince powerful employees of the organization of the potential of the project. Top management decides whether to continue with the project.
- *Development:* if it is decided to continue, a project group is set up to develop a prototype and perform market analysis.
- *Implementation:* top management decides whether to commercialize the project or implement it internally.

Success factors

Below, the seven success factors found within the cases are discussed.

*Scientifically valid***:** the biggest success factor of the innovation projects is that almost all the projects are based on scientific research. Only case number 7 is not scientifically valid but this is merely due to the fact that the project is in its first stages of development. Most initiators have a background in research or have their project tested during the development process.

Public attention: one project in particular, has received massive public attention. It has become world famous in the serious gaming industry, received a number of gaming awards (e.g. Best Serious Game & Best Applied Game Design, Dutch Game Awards 2013) and the initiators were invited to talk about the product at major technology events (e.g. Google TedTalks). This generated positive public attention for both the hospital and the game itself.

Passion initiators: almost all off the interviewees were highly passionate about their project. Most worked on the project during work hours but often they invested a significant amount of their personal time in the project as well. A few interviewees even provided financial resources themselves. One interviewee explained that it takes a lot of personal motivation to pursue an innovation project within the UMCG. *"We had to prove ourselves before interest of the hospital emerged. If me or my supervisor were to abandon the project, there would be no one else who could take over. But I would never want to quit, I see the project as my baby."* Another interviewee mentioned: *"This project came forth out of the passion and belief of the people involved, which is extremely beautiful."*

Involvement end user: some of the projects consulted their end users during the development of the innovation. One case used focus groups - consisting of patients and experts – which tested the latest versions of the application. Another case was based on a user-is-developer design. This allowed for co-creation sessions with the end user during the prototype development. *"With focus groups we looked at our end users wanted and demanded from the product. Eventually we conducted a pilot test where ten end users tested the product for six weeks at home. The goal of the pilot was to see whether the end users would actually use it and whether they were satisfied with the product."* They received positive feedback from the people who tested the game. Another interviewee stated: *"We knew well what our end users wanted from the product. It was crucial to work together with patients during the development of the application in order to know what they value and what not."*

Effectively implemented: cases 2, 3 and 5 have been effectively implemented or used by the UMCG. Patients and therapists of the center of revalidation can make use of cases 2 and 5. Case number 3 is used for teaching purposes within the radiology department and can be accessed by other departments as well.

Support from students: some projects have effectively used students of the University of Groningen or the Hanze School of Applied Sciences to support them during the project. One interviewee stated that it is relatively easy to find the right students who could support the project. The student desk of the UMCG can send out emails to other university departments which contact the right students. Students were mostly used for business advice and the development of software.

Large network: having a large network within the UMCG is an enormous advantage when starting an innovation project. There are a number of people within the hospital who can provide an advisory role on certain issues. The problem is that this can only be achieved through indirect ways. *"You need the right connections to get in touch with people in the hospital who can help you. The problem is that a lot of people do not know what the hospital can offer and that everything in the medical world goes indirectly. You have access to all of the email addresses of all of these employees within the UMCG, but if you do not know this person or are not formally introduced you will most likely not receive a response."*

Experienced difficulties

A number of experienced difficulties were found within the cases. In total, 13 different difficulties were observed. The difficulties market research and pricing strategy were constituted under the general difficulty marketing.

Dependency on major companies: where some of the projects focused on collaborating with smaller companies for their product development, some chose to pursue a strategy of working with an existing major company. Case number 1 is the best example within the researched projects. They decided to build their game on the existing platform of the Nintendo Wii, due to their large installed base and the fact that everybody in the world would be able to play the game. However, Nintendo brought out newer versions of the Wii during the development of the game. The first prototype was developed for the Nintendo Wii, but during the process Nintendo entered the market with its sequel the Wii U. Because of this the soft- and hardware of the serious game had to be redesigned, which caused some serious delays.

Software related problems: some projects experienced software related problems. These problems were mostly in terms of small bugs and errors in the software. The reason behind this is that there are simply not enough resources to playtest the game before release to locate and improve bugs.

Marketing: almost all of the interviewees had no prior experience in marketing and had to do everything themselves. Marketing medical products can be difficult due to a number of reasons. Case 1 displays a nice example of this: advertising in magazines was not an option since physicians obtain knowledge on new products from online academic medical journals. Contacting other doctors individually turned out to be very difficult as well. They initially thought, word of mouth would do the trick and because of all the positive public attention the product would go viral on its own. Unfortunately, this was not the case. Another option was displaying the product at medical conferences. However, the costs of doing so are extremely high. Another disadvantage of displaying on medical conferences is that the product is not immediately bought. They noticed that on average two years after display, the product was bought by other companies. As one interviewee stated: *"everything in medicine is slow. People can be extremely enthusiastic about a product, but that does not mean that they are actually going to buy it."* The main reason for this is that the process of buying new equipment takes a considerable amount of time because of the many protocols, procedures and safety tests which need to be adhered to within the hospital. This detains people from putting in the effort to try to buy a product for the hospital. *"The main mistake we made is that we initiated it as an academic project. We started with the problem, analyzed it,*

searched for solutions, implemented the solution and only after the product was finished we started to realize, but how are we actually going to sell this product? This process started way too late, we completely underestimated the importance of marketing". An interviewee of another project stated the following: *"we did everything in terms of marketing ourselves. Preferably we would have liked to transfer this part to a professional or an investor. This way we would be able to focus more on the contents and the development. Marketing is just not our field of business.*

Market research: most projects did not perform market research. When it was performed it was either based on the wrong pricing strategy or performed by students. One of the interviewees mentioned: *"we had to rely on the help of student interns for our marketing research, which makes it less professional."*

Pricing strategy: a number of projects experienced difficulty with choosing a pricing strategy. One case received suggestions on pricing strategies from multiple people within the UMCG. It was suggested that they should sell the application to individuals and base the price on a subscription fee. But since they had to do everything themselves this would have become a huge administration task. An extra person would have to be hired to take care of administration which would increase the costs of the app. Therefore the applied pricing strategy is based on a more manageable approach. They chose to sell the application for a fixed number of €345 per institution. *"This is in terms of administration a lot easier to manage but probably not the best way to make money. A lot of institutions are connected to other small institutions which use the application under the same name."*

Alignment different parties: many projects faced difficulty with the alignment of interests of the different parties involved. Some projects faced these difficulties during the collaboration with the external software developers. These are often smaller companies who worked on other projects simultaneously, which can cause serious delays for the development. One case worked together with the artificial intelligence department of the University of Groningen to incorporate a speech recognition element into the application. But their interests were to diverse: *"they needed money for another research but it turned out that what they developed was not nearly well enough for our application. It could not even distinguish the P from the B sound."*

Case 4 experienced difficulty with aligning the interests of the UMCG, the external commercial party and their own: *"the hospital is very focused on trying to get positive attention out of these projects, which is completely understandable. But they are also clinging onto intellectual property, even in cases where it is not profitable to do so. This almost became the deal breaker during the negotiations with the commercial party. The lawyers of the UMCG did not represent the same interests as the members of the research group for which they were setting up contracts. This has already led to the termination of other projects."*

Legal issues: a few projects experienced difficulty concerning legal issues. One case filed for CE marks themselves as well as the setting up of disclaimers: *"we set up our own disclaimers based on examples of others, which were later checked by a lawyer. As a speech therapist I have no experience with these legal issues. It would have been much faster to have a professional do the job so that I can focus on my own occupation"*. For aspects concerning data protection and privacy, they received help from the privacy-work organization of the

UMCG. *"We received a lot of support from them, but eventually we had to do everything ourselves.* Some interviewees do not even start with projects which would require CE marks: *"I focus on projects which can be implemented within the UMCG. If you want to bring your product to the market you would need a CE mark, FDA clearance, validation of your product etcetera. This takes a considerable amount of time and effort."*

*Communication different parties***:** most communication problems were experienced with the external software developers. As one interviewee explains: "*We proposed an idea about what we wanted and the game developers would agree. But when they came back to us they had developed something completely different. This has been an issue which has appeared in every stage of the process. It would have been very helpful to have someone who guides this communication process."* Another interviewee referred to the scrum method which was implemented by their software developers: *"at the beginning of the sprint meeting everybody decides what they should do during that period. This method is very different from what us researchers are used to. We are used to having long periods of time in which we can do research, not certain set dates on when we should deliver results. This increases the complexity of projects such as these where multiple partners from different backgrounds are combined."*

Intellectual property (IP): a number of projects faced difficulty with the determination of protection mechanisms of the IP. Because the projects are initiated and developed within working hours, the IP belongs to the UMCG in most cases. The UMCG is judged on the number of patents they own. Because of this, the hospital is very focused on patenting every project. One interviewee stated: "*in the hospital the idea exists that patenting is the best protection mechanism. They want to claim the rights on products through patents, after this is done the product does not really matter anymore. In our case you would have to patent software which is difficult, expensive and not very effective. Software is easily invented around, patents do not matter for software. It would have been better to use other protection mechanisms.*

Search for external commercial parties: many projects found it difficult to search for external commercial parties who could further develop the product. Some of the initiators wanted to stay involved when collaborating with an external party while others preferred to completely hand over the project. The initiator of case 3 explained that the product was initially destined to be used for internal purposes only. However, it turned out more university medical centers were interested in the product. When they realized the potential of the product to enter the external market they started looking for support from external initiatives. "*But I had to do too much myself, I do not have the time for this. Neither is it my ambition. It is not my profession to market products. By that time I am already focusing on a next project.* They looked for support from external parties who would market the product but they could were not able to find this. The external initiatives provided more of an advisory role instead of taking over the project. "*Those parties expect that the initiator wants to take the project to the next level, but I do not want to do that. I hoped that I could just give them the finished product and say good luck putting it on the market. A contract which stated my name as the initiator which recognizes a part of the IP to me would have been enough. A little profit to fund further*

research would be nice, but if that is not the case that's fine as well. I want to do research, not run a company. But apparently this is not possible.

Initiators who did want to stay involved in the project found it difficult to get in contact with external parties as well. They would have benefitted from advise on which company would be appropriate to collaborate with and someone with connections to the business world. One initiator stated that it took them a long time to get to the higher management of the commercial company. *"We contacted a sales person of the commercial company but eventually it took 2 years before we could sign the first contracts. We had to start from the bottom of the hierarchical period."*

UMCG structure/culture: "the core business of the UMCG is patient care, followed by science and education. Product development is often neglected." A number of projects expressed their concerns about the UMCG structure and culture towards innovations. If an innovation project is started and becoming official it has to be signed by the board of directors. Within the hospital they are the only people who are allowed to make something official. *"When you are in your exploration phase and want to work with external parties but it already takes half a year before the contract gets signed by the board of directors, this can be extremely frustrating. And it simply takes too much time. Especially with ICT, speed is everything."*

Another interviewee stated the following: *"At some points it felt like the hospital was almost counteracting our project. Maybe the hospital culture needs to change first to allow for more successful innovation projects. The hospital basically consists of little islands. People who have been in the same position for a long time and who want to exert influence on the way things are handled. They are used to exert their power in a certain way. People should be more open to new ideas or work procedures.*

Subsidies: filing for subsidies is probably one of the most important experienced difficulties. Every interviewee expressed their feelings towards the burden of filing for subsidies. The main problem is that it takes a considerable amount of time, work and effort. Above that you can only apply for one subsidy at a time which means that as soon as you are granted a subsidy, you have to start applying for the next one. This takes away time which could be spend on the further development of the project. As one interviewee explained: "*if my supervisor and I would not have continued searching for external ways of financing, the project would have stranded. I know multiple people who haven't even tried to get subsidy because of the enormous amount of time and effort it takes compared to the relatively low rate of success. A friend of mine had to stop his project because they ran out of funding. This is such a pity and waste of talented researchers and potentially successful products."* Another interviewee stated: *"It is generally known in medicine that it takes more time to seek funding for your research than the actual research itself. The time it takes to receive the right amount of funding is extremely long, rejections are more common than acceptations and the whole journey is accompanied by a lot of frustration."*

Prototype development: the projects which contained a hardware part mentioned that they found it difficult to develop the first prototype. One interviewee mentioned that it would be helpful to have a group of people within the UMCG who could develop the first prototype. At the moment the initiators mostly fabricated the first prototype themselves, since the use of

external companies is too expensive at that stage of development. The availability of having a proper prototype is very beneficial when applying for subsidy or contacting an external commercial party.

Advice plan

Now that the success factors and experienced difficulties have been established a suitable advice plan can be provided. This section will discuss the advice for a central innovation hub which can be implemented by the UMCG to better organize and support innovation projects. The advice plan is divided into four main sections which are being referred to as (1) central innovation hub (2) boundary spanning network, (3) business advice and (4) ICT/legal advice. The central innovation hub can be considered as the main body of which the other three categories are part of. It is important to note that all of the four categories are interrelated. Figure 1 provides a framework of the hub.

Central innovation hub.

The hub envisions the central place of where employees can go to when they want to initiate innovation projects. It consists of a board of multidisciplinary team members who will assess the innovation projects. It is important that these board members can connect the healthcare world to the business world, have an innovative spirit, and can exert influence within the UMCG.

In order to prevent an overload of innovative ideas arriving at the hub a first screening should be held. Nortel Networks created a radical-innovation hub, where requests for innovative proposals from employees were collected on a website to stimulate idea generation (Leifer et al., 2001). This hub could effectively use an employee suggestion systems (ESS) to collect the proposals. An ESS is a highly effective, low-cost way to encourage and exploit the participation of every employee in the company (Fairbank & Williams, 2001). By virtually inviting all employees, direct awareness and notification of the newly implemented hub is created. The ESS is used to encourage entrepreneurship among employees by showing that the employer is highly interested in individual creative proposals (Fairbank & Williams, 2001). Above that, the ESS could be used to look at innovative ideas from colleagues stimulating cooperation between similar projects. A number of interviewees stated that they would have liked to have an overview of all of the initiated innovation projects to learn from each other or to combine forces.

Nortel Networks used a first contact person of the hub to screen the ideas. When a proposal would be selected the contact person would help the initiator to transform and develop the idea into a business concept (Leifer et al., 2001). This will also be done in the new innovation hub. If the idea gets submitted, the initiator can give a pitch to the board members explaining his idea and business concept. The board members will consult whether the idea contains potential opportunity for further development. Essentially, the board will perform make or break decision making. If they realize potential – the make decision – further project guidance as well as initial subsidy will be provided. In case of a break decision, the project gets rejected and the initiator has the choice to leave it at that or to further develop the project in his own time.

The overall project guidance will consist of the availability of using the other three categories: boundary spanning network, business advice and ICT/legal advice. The initial

funding of the project will be provided by the central innovation hub. This relieves initiators from the constant burden of applying for subsidies, creating more time for the project development. The subsidy funding can be seen as a vicious cycle. Part of the profit the UMCG receives for owning the IP of a successfully commercialized project will be reinvested into the subsidy fund.

Two other aspects are of high importance to the hub. First, the board of the hub should have complete autonomy. The board needs to be able to make decisions autonomously, without interference of other top management of the UMCG, to ascertain the continuous flow of innovation projects. At the moment it takes too much time to make an innovation project official, which puts significant delays on most projects. Second, the hub should be flexible towards the involvement of the initiators during further development. Some initiators expressed that they only want to develop a project, after finalization they want to completely hand it over to a third party. These type of projects should be transferred to the UMCG spin-off who further markets the product. Other initiators wish to stay involved during the whole new product development process. These initiators should be guided during their search for external commercial parties and be given advice and assistance from the business and ICT/legal department of the hub.

Boundary spanning network.

Hospitals are traditionally viewed as fragmented organizations (Vandenberghe, 1999; Lega & DePietro, 2005; Stolte, 1979). The interviewees confirmed this organizational culture and displayed the need for a more cohesive internal and external network. Internally, the problem exists that many employees do not know what the UMCG can offer and where specific knowledge can be found. Externally, there is no central network either. There are numerous local initiatives who provide services in the development of healthcare innovation projects, but there is no overview of who does what. In a case study of Youtie & Shapira (2008) a similar problem was experienced. They researched the transformation of the Georgia Institute of Technology (Georgia Tech) from a knowledge factory to an innovation-promoting knowledge hub. They suggested that to facilitate the exchange of knowledge needed for an innovation hub, boundary-spanning roles needed to be created and accumulated. A boundary spanning activity is used to facilitate the communication of knowledge across boundaries both internal and external to an organization (Youtie & Shapira, 2008). Boundaries hinder the transfer of knowledge and therefore a boundary spanning network is needed to avoid this.

The internal boundary spanning network can provide an overview of the important actors involved in innovation projects within the UMCG. This way the specific knowledge certain employees possess can be found and transferred. Initiators and other star scientists can be easily aligned through the ESS. Star scientists are employees who can serve as boundary spanners to provide specialized knowledge about new research breakthroughs (Zucker & Darby, 1996). Similarly, can other employees who have connections to the external environment based on their involvement and interactions with scientific, business and public policy council and boards (Youtie & Shapira, 2008). The internal network also needs to align all the different facilities the UMCG can offer. These facilities are currently highly fragmented and not known to most employees. An example would be the medial tool shop which can assist in the development of hardware prototypes.

The external boundary spanning network has the function to provide an overview of the numerous external actors which could be beneficial for the innovation development process.

These actors operate in multiple sectors such as in economic, governmental, community and educational spheres (Youtie & Shapira, 2008). Four external actors are important to the boundary spanning network of the UMCG. External commercial companies is the first one. An overview should be made of interested and trustworthy external commercial companies willing to collaborate with innovation projects of the UMCG. At the moment, every initiator searches for external partners individually. A few of the studied cases contain applications, these initiators have all searched for software developers themselves. Experiences of the collaborations have not been shared with others. If collaboration with commercial parties turned out to be successful in previous projects, these experiences could be shared and collaborations with trustworthy partners could be maintained, simplifying the search for the right external partner.

The second actor is the commercial spin-off of the UMCG. The spin-off can be used to further market the innovation projects of initiators who want to hand over the project completely after development. Most interviewees were not very satisfied with the current spin-off of the UMCG. The Triade foundation is seen as the commercial daughter of the hospital. However, some projects were rejected by Triade. Interviewees also expressed that they still had to fulfill an entrepreneurial role when collaborating with Triade, something of which they have no ambition for. With the new hub screening and selecting the projects which show the most potential, these projects should be able to be directly transferred to the spin-off.

The third actor are the universities in the region. A close collaboration with the University of Groningen and the Hanze School of Applied Sciences can facilitate better knowledge transfer. Also the availability of using students from different departments who can support innovation projects with their specific knowledge - as e.g. a thesis project – could be effectively used.

The last actor concerns connections to the local government and community. Close ties with the government and community can provide useful insights from the region. It can provide insights on what is valued by the community, what the region would benefit from and what the current trends are related to healthcare in the region.

A boundary spanning network which connects both internal and external actors is an efficient way to reduce the fragmented organizational structure of the hospital. It facilitates the transfer of knowledge and alignment of important actors. It is therefore an essential part of the new central innovation hub.

Business advice.

The results concerning the experienced difficulties of the interviewees show many business related problems. These difficulties can be classified into three main categories: intellectual property, marketing and communication/negotiation. The section business advice will consist of two parts which incorporate these three categories: the Technology Transfer Office (TTO) and the VentureLab.

Technology transfer offices are new organizational entities which have emerged at research universities (Siegel et al., 2004). Youtie & Shapira (2008) highlight the importance of TTOs as a link between the research, entrepreneurial and industrial communities. TTOs are used to manage and protect the intellectual property of research universities. Siegel et al. (2004) state that the role of the TTO is to facilitate commercial knowledge transfers through the licensing of inventions or other forms of intellectual property resulting from university

research. The UMCG could greatly benefit from a TTO as well. The determination of protection mechanisms for the IP is one of the experienced difficulties of innovation initiators. Five out of the seven cases experienced problems concerning this matter.

The UMCG mainly relies on patents as a protection mechanism. Cohen et al. (2000) researched the main reasons of why firms use patents as a protection mechanism. They found that medical equipment and drug firms use patents as a protection mechanism for their product innovations to: prevent copying, to block competitors, to prevent lawsuits, to use in negotiations and to enhance their reputation. Regarding the effectiveness of protection mechanisms concerning medical equipment they found that lead time is the most effective mechanism, followed by patents, complementary services, secrecy and complementary manufacturing (Cohen et al., 2000). Similar results were found for product innovations related to drugs. It can thus be stated that patenting is an effective protection mechanism for products which have a medical equipment or drug nature. However, all of the innovations studied for this paper do not have such components. Cohen et al. (2000) found that the average effectiveness of patents considering all industries was lower than the use of secrecy, complementary sales/services, lead time and complementary manufacturing. This shows the importance of considering other (in)formal protection mechanisms besides patents as well. The TTO could play an important role in this. They need to determine the most effective way to protect innovations and knowledge. By looking at each project individually the best protection mechanism can be selected. This is necessary because of the large diversity in nature between the initiated projects. What works for one project, might not work for another.

The two remaining categories related to business problems – marketing and communication/negotiation – will be resolved by the VentureLab part of the business advice section. Georgia Tech has built a VentureLab for their transformation to the innovation-promoting knowledge hub. Their VentureLab uses the knowledge generated by research and links it to commercial opportunities. It thus creates linkages with experienced entrepreneurs, local businesses and venture capitalists (Youtie & Shapira, 2008). This is an attribute which is very useful for the new central innovation hub of the UMCG. From the interviews it was concluded that a link between business and research/healthcare is largely missing and needs to be improved. The VentureLab will need to consist out of people who have experience in both fields. These people will assist the initiators with marketing and communication/negotiation with external partners. In the case of initiators who want to hand over the project completely, these matters will be resolved by the spin-off.

The category marketing contains a few of the experienced difficulties resulted from the interviews. It will focus on marketing, market research and pricing strategy. Many interviewees had no prior experience with marketing and would greatly benefit from marketing support. The VentureLab team needs to support the initiators by providing marketing advice and guidance, performing market research and researching the correct pricing strategies.

Communication and negotiation problems with external parties is another experienced difficulty which will be addressed by the VentureLab team. Because of their medical/research background, initiators found it often difficult to effectively communicate with commercial parties. The VentureLab team is able to link these two fields and can therefore assist in more efficient communication. Initiators should be made aware of the business culture and certain methods often used by companies (e.g. the scrum method for software development). The difficulty of understanding each other’s language also holds for the negotiation and alignment

of different parties. The VentureLab team can perform a mediating role during communication/negotiation with external partners having the interests of the initiators and UMCG at heart.

ICT & legal department.

The last section of the central innovation hub concerns ICT and legal advice. As can be seen in table 1, all of the projects investigated for this research contain a software element. The projects used external commercial parties for the actual development of the software, but still had to figure out a number of ICT issues themselves (e.g. setting up disclaimers, issues concerning data protection and privacy regulations). They were provided with advice, but would have benefitted more from people who could take over this part of the project.

The same problem holds for legal advice. Within the European Union, medical tools need to comply with certain guidelines and protocols in order to receive a CE mark (Guidelines medical tools, 2017). A CE mark signifies that products sold within the European Economic Area have been assessed to meet high safety, environmental, health and protection requirements (CE mark, 2017). The filing for this CE mark and following procedures can be an enormous burden for someone without a legal background. As mentioned before some initiators do not even try to market their innovation because of this heavy burden. A number of other initiators had to file for CE marks themselves. Everyone had to learn the process of filing, where it would be much more efficient if this was done by someone with a legal background.

The purpose of the ICT & legal department is to handle these issues. They will support the initiators of innovations projects concerning ICT and legal problems by taking over the issues mentioned above.

Implementation

This section will provide some advice for the implementation of the new central innovation hub. In order for it to work effectively, it is suggested to implement the hub for a smaller section of the UMCG first. The UMCG is such a large organization that implementation on a hospital wide level may be too difficult to be accomplished at once. Therefore, I suggest to focus on eHealth innovations first. The term eHealth can be defined as a consumer-centered model of healthcare where stakeholders collaborate, utilizing ICTs, including Internet technologies to manage health, arrange, deliver and account for care, and manage the health care system (Alvarez, 2002). All of the studied innovations contain a software element and can be considered as eHealth projects. Above that, the policy of the UMCG recognizes the increasing importance and use of eHealth projects, making it a perfect setting for the pilot version.

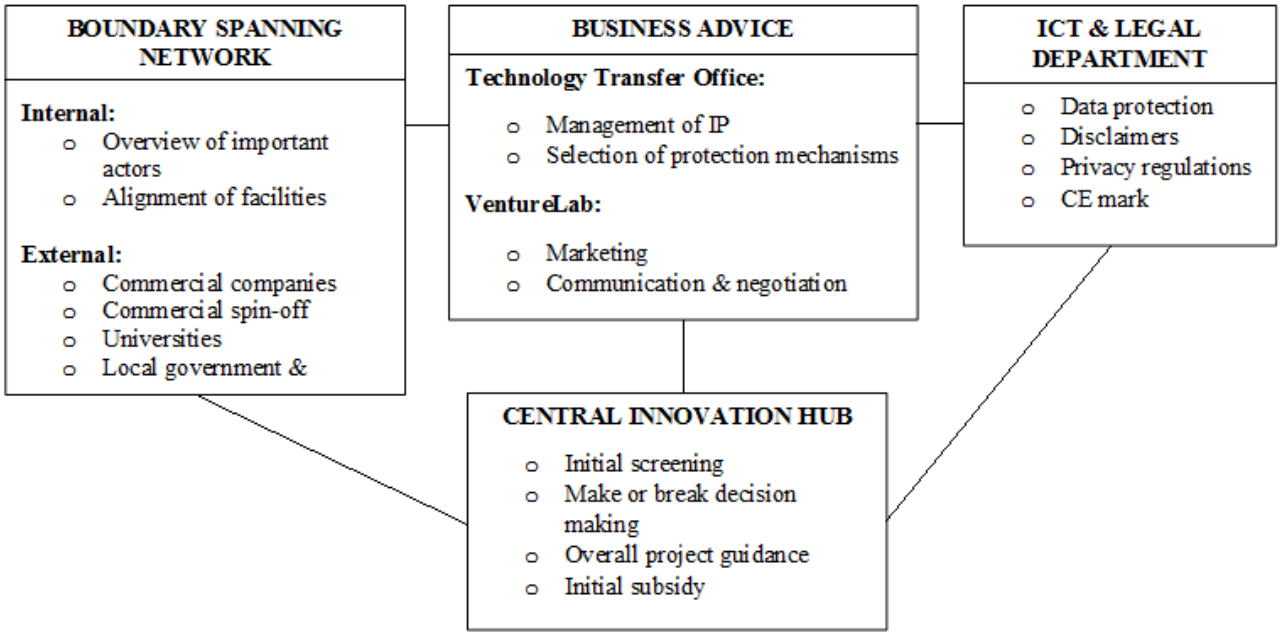

Figure 1. Framework of the central innovation hub

DISCUSSION

Professional service firms and innovation have become increasingly important in today's business environment. Within the Western economies, PSFs represent a growing part of employment and value creation (Aharoni, 1993b; Løwendahl, 2000; Løwendahl et al., 2001). History has shown that innovation management is becoming increasingly important as well. The shift from innovation projects initiated by lone inventors to companies expanding there innovative efforts, indicates the rise for more knowledge on effective innovation management approaches. This study combined these two increased fields of interest and tried to answer the question: how are innovation projects organized within professional service firms? It can be considered a difficult topic and answering this question is not as easy as it might seem. One could say that it is a relatively simple question but the topic raises a number of challenges.

The differences between types of PSFs illustrated by Von Nordenflycht (2010) postulates the first challenge. PSFs differ significantly in the types of services they provide which makes effective comparison difficult. The taxonomy of Von Nordenflycht (2010) contains four different categories of professional service firms. Ranging from firms which match all three characteristics to firms who only contain one. It might be effective to first determine the category to which a PSF belongs, after which it can be compared to PSFs belonging to the same group.

Second, innovations created by PSFs often consist of both product and service innovations. Especially in the case of hospitals since they do not share the low capital intensity characteristic of service firms (Von Nordenflycht, 2010). This can also be seen within the studied innovation projects of the UMCG. Many of these projects are in essence product innovations but contain a service element as well. Academic literature abundantly focuses on product development, but theories and models on service development and

innovation remain scarce. Above that, contradiction exists in whether products and services can and should be compared. Most new service development theories and models are built upon knowledge on new product development within the manufacturing industry. Often these theories are inspired by Cooper's (1990) stage gate model of new product development. Research simply uses this theory and adapts is to a service context (e.g. Avlonitis et al., 2001). Scholars remain ambiguous as to whether service and product development can be compared. Coombs & Miles (2000) distinguished three different perspectives on the comparison of products and services: the assimilation, demarcation and synthesis approach. The difference in these three approaches clearly shows the remaining ambiguity within academic literature on the comparison of products and services.

The third challenge is that innovation projects within PSFs are mostly initiated by firm employees (Anand et al., 2007; Heusinkveld & Benders, 2005; Mom et al., 2007). Innovation literature does not focus much on this issue, therefore literature from other academic fields was examined. Literature on the lone inventor and intrapreneurship were obtained from the field of entrepreneurship. The aspect of strategic recognition from strategy research. These three fields focus on the importance of employee involvement within PSFs. This is especially important in the organization of innovation projects within PSFs, because of their high involvement of employees. The academic problem solving part of this study focused on researching innovation projects initiated by healthcare professionals within the UMCG. The results show that the organization of innovation projects is not formally structured within the hospital. In fact, there does not appear to be any central organization at all. Healthcare professionals experienced a number of difficulties during the development of the projects. Regarding some problems, the healthcare professionals were able to find support. However, this support was mainly in the form of advice. In the end, they had to do everything themselves, even when they did not have entrepreneurial ambitions. Academic literature indicates the challenge in the commercialization of innovations developed by lone inventors and entrepreneurs (Åstebro, 1998; Holbrook et al., 2000). This challenge can also be clearly seen in the results of the cases. Only two out of the seven researched innovation projects were commercialized.

Based on the success factors, experienced difficulties and academic literature, an advice plan for a new central innovation hub for the UMCG was created. The key purpose of the hub is to centrally organize the development of innovation projects, the encouragement of UMCG employees to engage in innovation and to simplify the initiation of innovations. The hub consists of four interconnected parts: the main body of the hub, the boundary spanning network, the business advice section and the ICT & legal department. This structure was especially designed to be implemented within the UMCG.

Answering the research question from the perspective of the UMCG is quite simple. At the moment there is no structured organization of innovation projects within this academic medical center. Healthcare professionals take care of the development of the project themselves, and little support is facilitated. The hub can be considered as a change plan to more structurally organize this. However, the results from the case study can be considered to be specific to hospitals. The high capital intensity characteristic which hospitals contain are not experienced by all PSFs. This characteristic results in de combination of product and service innovations initiated by the healthcare professionals. Other types of service firms (e.g.

law firms) who have low capital intensity are more likely to develop mostly service innovations. Therefore, the research question is more difficult to answer in the case of all of the different types of professional service firms. Sundbo (1979) describes the organization of innovations projects within top strategic organizations. This study provided some insights in that particular type of PSF. However, providing an answer to the general organization of innovation projects within PSFs seems to be beyond the scope of this research. Different types of PSFs simply differ too much in nature to allow for effective comparison. The above mentioned challenges clearly describe this.

Theoretical implications

This research contributes to academic literature on multiple fronts: first, it connects the innovation literature with entrepreneurial literature. Zhao (2005) reviewed academic literature and found that many studies deal with either innovation or entrepreneurship, that some have mentioned the relation between the two, but that studies exploring the synergy between the two remain scarce. The two fields of business are often seen as separate when in fact they are closely related to each other. Entrepreneurship is mostly associated with small businesses. However, the concepts of corporate entrepreneurship and intrapreneurship show that entrepreneurial activities occur in large organizations as well. Zhao (2005) argues that innovation and entrepreneurship are complementary because of two reasons. On the one hand, innovation can be seen as a source of entrepreneurship. On the other hand, entrepreneurship better ensures that innovations become commercially available. This can also been seen within this research. Because of the innovations healthcare professionals come up with, they take upon an entrepreneurial role within the hospital. Most of these initiators have an entrepreneurial spirit and would like to commercialize their product. This entrepreneurial spirit drives the healthcare professionals' tremendous efforts for the commercialization and implementation of their product. Thus, this study shows the close relationship between innovation and entrepreneurship.

Second, it links the strategic recognition concept of Burgelman & Grove (1996) to professional service firms. Burgelman and Grove (1996) place emphasis on the ability of top management to recognize the strategic importance of lower managerial initiatives. Listening to representatives from all levels of the organization can contribute to diversifying strategic insights and prevent companies from falling into the valley of death. Lower level employees know more about the external environment since they are closer to it and are not affected by company beliefs and strategies (Burgelman & Grove, 1996). This bottom up approach is important to be recognized within PSFs, because of the fact that most innovations within this sector arise from creative ideas of employees. Anand et al. (2007) even state that within PSFs competitive advantages are gained through the knowledge-based innovations of its employees.

Third, it extensively describes the difficulties experienced by lone inventors (in this case healthcare professionals) whereas other researches do not elaborate much on this point. Substantial research on the lone inventor can be found within academic literature. These studies mostly focus on the type of innovation lone inventors create, the reasons for this and differences between innovations from lone inventors and corporations. However, research on what exact difficulties lone inventors experience and how they organize their innovation projects remains scarce. The case study of this research analyzes and describes these

difficulties. It provides a more complete picture as to why innovation projects of lone inventors face difficulty commercializing.

Fourth, this research focuses on the healthcare sector of PSFs, where previous research mostly focuses on financial service, law and management consulting firms (Von Nordenflycht, 2010). To my knowledge there is no research which specifically focuses on innovations developed within hospitals. This study therefore shows valuable insights on the organization of innovation projects within an academic medical center.

Managerial implications

Concerning managerial implications I would refer to the advice plan section within this research. This extensively describes the new innovation hub and advice on the implementation of the hub. Although this advice plan is specifically designed for the UMCG, valuable knowledge can be gained from it for other professional service firms. As mentioned before, innovation projects within PSFs are mostly initiated by employees. Other firms could learn from the hub's more structural and formalized organization of innovation projects. A central place where employees can go to with their innovative ideas improves efficiency and provides an overview on who is working on what. The screening and make/break decision making by the composed board further smoothens the process. The overall project guidance by the three other parts of the hub and initial funding should be based on the specific characteristics of the firm. The hub also decreases the cognitive limitations of managers to objectively consider potential creative ideas of employees (Fairbank & Williams, 2001). Above that, the more formal structure of the hub reduces the risk of cat herding which is often experienced by PSFs.

Limitations and suggestions for future research

The largest limitation of this research is time constraints. Because of the limited time frame only seven innovation projects could be researched. Also, for most cases only one person could be interviewed. Preferably, two persons per case would have been interviewed and follow-up interviews would have been held but unfortunately this was not possible within the time frame. Another limitation of this study is that only innovation projects within the UMCG were researched. Future research could look at the organization of innovation projects within different academic hospitals in order to increase comparability. On average, a clear model or theory on the organization of innovation projects within PSFs is still missing within academic literature. The article of Sundbo (1997) describes the four distinctive phases of organization within top strategic organizations but this remains a very general description. More detailed research on how employees come up with innovations, how are they supported, where problems are experienced and what the success factors of these innovations are is needed. This study answers these questions but only for the particular case of the UMCG. Future research could investigate these questions for other types of professional service firms. As mentioned before, academic literature recognizes the challenge of the commercialization of innovations by lone inventors and entrepreneurs. However, it does not provide much advice on how this issue could be overcome. Future research could look into this particular problem.

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APPENDIX

Table 1. Overview of the general description of the cases.

Innovation Project	Type	Product	Department initiators/interviewees	Years of development	Available of market
1	Serious game	Software & hardware	Surgery	8	Yes
2	Application	Software	Center of revalidation	5	Yes, and implemented by center of revalidation
3	Web based image classroom voting tool	Software	Radiology	7	Only implanted by UMCG
4	Medical equipment	Software & hardware	PhD candidate	4	Not Yet
5	Service	Concepts, service & software	Center of revalidation	13	Only implemented by center of revalidation
6	Exergame	Software	Department of movement sciences	5	Not yet
7	Application & service	Software, service	Nuclear medicine	0.5	Not yet

Table 2. Overview of the success factors and experienced difficulties.

		1	2	3	4	5	6	7
Success factors	Scientifically valid	**X**	**X**	**X**	**X**	**X**	**X**	**N/A**
	Public attention	**X**						
	Passion initiators	**X**	**X**		**X**	**X**		**X**
	Involvement end user		**X**		**X**		**X**	
	Effectively implemented		**X**	**X**	**N/A**	**X**		**N/A**
	Support students	**X**		**X**				
	Large network				**X**	**X**	**X**	**X**
Experienced difficulties	Dependency major companies	**X**			**X**			
	Software related problems	**X**	**X**					
	Marketing	**X**	**X**	**N/A**	**N/A**		**N/A**	**N/A**
	Market research	**X**		**N/A**	**N/A**		**N/A**	**N/A**
	Pricing strategy	**X**	**X**	**N/A**	**X**		**N/A**	**N/A**
	Alignment different parties	**X**	**X**	**X**	**X**		**X**	**X**
	Legal issues		**X**	**N/A**	**X**		**N/A**	
	Communication different parties		**X**		**X**		**X**	**X**
	Intellectual Property		**X**	**X**	**X**	**N/A**	**X**	**X**
	Search external			**X**	**X**	**X**	**X**	**X**

	commercial parties							
	UMCG structure/culture			**X**	**X**	**X**		**X**
	Subsidies	**X**	**X**	**X**	**X**	**X**	**X**	**X**
	Prototype development	**X**			**X**			