The users' value of business center concepts for knowledge sharing and networking behavior within and between organizations

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Summary

The users' value of business center concepts for knowledge sharing and networking behavior within and between organizations

It has been recognized that knowledge is one of the most important resources of an organization. A network of relationships and face-to-face interactions between individuals are important for organizations to share and obtain knowledge. To increase opportunities for interacting and knowledge sharing, organizations are increasingly looking for accommodation in business centers. A business center can be described as a building with a number of spaces and possibly some common facilities and/or services, which are offered to multiple organizations. Although business centers as a product have become more branded, the business center sector is still difficult to define and there is no clear classification of business center concepts. Many property managers promote and brand their business center as being innovative work environments due to their shared workspaces, facilities and services. However, research on the influence of shared spaces and facilities/services on networking and knowledge sharing behavior within and between organizations has hardly received any attention. Therefore the aim of this PhD project is 'to identify business center concepts and to analyze the influence of characteristics of business center concepts on knowledge sharing and networking behavior of business center users.' This PhD project consists of two main parts, namely identifying different types of business center concepts and analyzing knowledge sharing and networking behavior in business centers.

Based on the literature review, four types of business center concepts are distinguished, namely regular business centers, serviced offices, coworking offices and incubators. Data collected among the property managers of business centers in the Netherlands show many significant differences between the business center concepts. First, regular business centers appear to exist longer than the other types of business centers, have no specific objectives, offer mostly a one year, 2 year or a 5 year lease contract and have a low service level. Serviced offices are mostly newer business centers, are profit oriented, have many objectives, are focused on SMEs and self-employed people, offer a lot of shared spaces, have a high service level, mostly based on a 'pay as you use' principle and offer workspaces based on a short lease contract. Coworking offices have the objective to stimulate knowledge sharing and to create a working community. These offices offer social- and collaborative spaces, mostly based

on a one year lease contract, have a high number of different spaces and offer catering. Finally, incubators appear to be mostly non-profit oriented, support and facilitate start-up enterprises and have the objective to stimulate economic development and growth in the region. Thus, the analyses confirmed that the four business centers concepts from literature also exist in the market and indeed have unique selling points to attract tenants.

The review of the relevant knowledge sharing and networking literature showed that knowledge sharing is related to several personal characteristics, organization type, offered services and the physical work environment of business centers. Although many relations have been recognized by previous research, these relations have not been considered in a single model in the context of a business center. Data collected with a questionnaire among the 268 business center users from 53 business centers in the Netherlands was analyzed in an integrated fashion using a path analysis. Relations were found between spaces, namely a canteen, event space, lounge room and meeting space, and the perceived frequency that people socially interact. Furthermore, a relation was found between an individual workspace and social networking and knowledge sharing behavior within organizations. In addition, a path model was estimated with services offered by the business center. Results show that consultancy services, managed technology and the use of coffee and tea services influence knowledge sharing and/or networking between organizations in business centers. To analyze relations with the perceived sharing of different types of knowledge, a Seemingly Unrelated Regression (SUR) analysis was performed. The results show that public and private non-codified knowledge is more frequently shared with people from other organizations by those who more frequently use an event space, lounge space, canteen or consultancy services. Furthermore, a relation was found between knowledge sharing within organizations and the use of individual closed workspaces, meeting spaces, a restaurant and gender.

To analyze real-time face-to-face interactions and knowledge sharing in business centers, face-to-face interaction data was collected by means of a questionnaire among 100 users of seven business centers in the Netherlands. In addition, an Experience Sampling Method (ESM) was used to collect data on face-to-face interaction characteristics and people's knowledge sharing behavior. A mixed multinomial logit model (MMNL) was used to analyze the choice of sharing different types of knowledge sharing behavior. The results indicated that only a relation was found between a cellular office and sharing tacit knowledge. Tacit knowledge appears

to be shared more frequently during discussions/debates, meetings and when receiving or giving information. A second MMNL model was used to analyze the location choice for face-to-face interactions. Results of this model imply that knowledge is less frequently shared when the interaction took place at a café/restaurant. The propensity that people who work in an open-plan office have a face-to-face interaction in a meeting space is higher compared to the other office concepts.

Overall, results of this research give insight into the existing business center concepts, their characteristics and (dis)similarities between the concepts. Furthermore, this study showed relations between the physical work environment (i.e., office concept, (informal) spaces, workspace type and workspace use) and knowledge sharing and networking behavior. These results will help real estate owners/developers to make well informed decisions about the type of business centers that they want to develop or invest in and to respond optimally to the needs and preferences of the users in terms of knowledge sharing. It can also be used by national and local governments to promote regional development of business areas and preferred business center concepts. For users of business center concepts, the results are important to get more insight in which factors of the physical work environment could affect their knowledge sharing and networking behavior.

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Introduction

1.1 Introduction

Office concepts have changed a lot since the cellular offices in the 1950s (Gottschalk, 1994) and today they are still changing because of new ideas about working and the work environment (e.g., Vuokko et al., 2015; Ouye, 2011). Generational differences lead to different work environment preferences, which change the nature of office design (Joy and Haynes, 2011; O'Neill, 2011). Furthermore, the demand for workplaces has been decreasing, due to the increase of small companies and freelance workers, new (ICT-driven) ways of working, 'footlooseness', telecommunication, and related developments (e.g., Saurin et al., 2008; Ketting, 2014). In addition, developments in the information and communication technologies (ICTs) have led to more fluid and mobile workplaces (Cole et al., 2014). Some aspects of physical workplaces are being replaced by digital technologies. For example, virtual meetings take place through video conferencing or screen sharing technologies (e.g., WebEx, GoToMeeting or Skype) (Passerini et al., 2012). Also, people are increasingly working at remote locations, such as working at home, 'hot-spots' in public venues (e.g., café, restaurant, or hotel) or when traveling between two locations (e.g., planes, trains, and boats) (Cole et al., 2014).

There is also a growing demand for other spaces in the office itself than a regular workplace, such as meeting areas, project spaces and event spaces (Barber et al., 2005; Harris, 2015), because of the increasing social importance of office buildings as a setting for face-to-face interactions (e.g., Sykes, 2014; Van Meel and Brinkø, 2014). Organizations are increasingly occupying office space in multi-tenant buildings due to the decreasing need of workspace, the increasing need for flexibility (e.g., Gibson, 2003), expected higher user comfort, and the higher level of shared services and facilities that are offered there (e.g., Barber et al., 2005; Dielemans, 2013). In addition, more and more self-employed people are looking for a workplace outside home, often in a business center. This offers them network opportunities, improves the balance between work and private life, and provides access to various

facilities (e.g., ICT infrastructure and spaces for meetings or teaching courses) (De Vries et al., 2006).

High vacancy rates of single tenant offices have motivated the redevelopment of many of these offices into business centers, thereby fueling the additional growth of this sector (Lokhorst et al., 2013). In addition, municipalities increasingly steer on facilitating start-up enterprises, SME's and self-employed people in business centers that offer affordable office space with a low service level (Mensen and Van Rijt-Veltman, 2005). Over the past decades, office space in business centers has been improved and extended with shared facilities and services to create value for both the tenant and the office owner (Peltier, 2001; Harris, 2015). Although business centers as a product have become more branded (Gibson and Lizieri, 1999), the business center sector is still difficult to define. It consists of several distinct types of properties and has traditionally been formed by many players (Calder and Courtney, 1992). Gibson and Lizieri (1999) observed there is no single business center market, but that it is differentiated by the type of tenant, quality of accommodation, services, and facilities. Due to the current trends, this is likely to have increased even further.

Some previous studies classified business centers into subgroups (e.g., Calder and Courtney, 1992; Van den Berg and Stijnenbosch, 2009; Ketting, 2014). These studies mentioned serviced office centers, incubators (managed workspaces) and regular business centers (commercial business centers). However, it is also recognized that new concepts have emerged, based on these types of business centers (Ketting, 2014; Parrino, 2013). One of these concepts is the widely discussed notion of the 'coworking space', which offers a shared collaborative work environment in a variety of settings (e.g., Moriset, 2014; Uda, 2013; Huwart et al., 2012; Parrino, 2013). Other researchers analyzed in detail one specific business center concept (e.g., Gibson and Lizieri, 1999; Moriset, 2014; Bruneel et al., 2010). However, they did not describe in detail the differences between different business center concepts and the characteristics defining them.

One of the most valued aspects for tenants of business centers is the opportunity for interaction and knowledge sharing with other tenants (Ketting, 2014). Knowledge sharing can be defined as an activity through which knowledge is exchanged between individuals, groups, or organizations (Odenthal et al., 2011). To stimulate interactions and knowledge sharing, organizations increasingly strive for more interactive work environments (Allen et al., 2005; Sykes, 2014). Therefore, the demand for other spaces than regular workspaces is increasing (e.g., event spaces, informal meeting spaces and project spaces) (Harris, 2015). Knowledge sharing

behavior has also become increasingly important for organizations (Israilidis et al., 2015) because knowledge is a vital source for an organizations' performance, innovative capabilities and sustainable competitive advantage (Wang and Noe, 2010; Ngah and Ibrahim, 2010). It is believed that innovation increases employment and the productivity of organizations and that organizations that are more innovative are more successful (BIS, 2011). Specifically for small or medium enterprises (SMEs) and freelancers (i.e., main target groups of business centers), networking and knowledge sharing behavior is highly important (Carr et al., 2010; Vajjhala, 2013). These organizations often share knowledge and innovate through interacting with other organizations because of their small size (Asheim et al., 2003).

Interactions and the use of network ties (i.e., relations) are needed for knowledge sharing behavior among individuals and groups (Marouf and Doreian, 2010). A higher frequency of interactions could, for example, lead to stronger ties and eventually to more knowledge sharing behavior (Van Wijk et al., 2008; Suckley and Dobson, 2014). Moreover, knowledge sharing and creative and innovative behavior is most effective through spontaneous face-to-face interactions (Ngah and Jusoff, 2009; Wang and Noe, 2010). However, creating an effective workplace design that stimulates networking (i.e., interactions) and knowledge sharing remains a major challenge (Kastelein, 2014).

In general, there is hardly any empirical research on business centers and even less with regard to networking and knowledge sharing behavior. Previous studies have mainly focused on interacting and knowledge sharing behavior within (large) organizations in single-tenant buildings. These studies have demonstrated that the physical work environment indeed influences interaction patterns and knowledge sharing behavior within an organization (e.g., Rachid et al., 2006; Wineman et al., 2009; Appel-Meulenbroek et al., 2017; Kastelein, 2014). Research has shown that interactions often occur in or near workspaces (e.g., Rashid et al., 2009), which underlines the importance of workspaces for knowledge sharing behavior. Shared facilities, and an open common workplace could stimulate networking and knowledge sharing behavior among employees as well (Staplehurst and Ragsdell, 2010; Kastelein, 2014). In addition, informal spaces allow people to relax and connect with other individuals, which might lead to more trust among them and in turn also might lead to more willingness to share knowledge (Chevez and Aznavoorian, 2014).

Although, many business centers are promoted as an interactive work environment and with knowledge sharing as their unique selling point (e.g.,

incubators and coworking spaces), it is still not clear whether and where in these buildings organizations interact and share knowledge and how this behavior is facilitated through the physical work environment of business centers. As, the opportunity for networking and knowledge sharing is seen as one of the main advantages of business centers for organizations, research on the influence of the physical work environment in business centers is necessary. Existing studies on knowledge sharing and innovation focus on knowledge sharing within organizations (e.g., Hoadley and Pea, 2002; Berends et al., 2014) or focus on knowledge sharing between organizations on a regional or global scale (e.g., Visser and Atzema, 2008; Bathelt et al., 2004). Knowledge sharing between organizations in a single building has not received any attention from knowledge and innovation researchers.

1.2   Research objective and questions

To assess the added value of business center concepts on networking and knowledge sharing, we need to understand how networking and knowledge sharing takes place and which aspects of the different business center concepts stimulate knowledge sharing. This requires an analysis and clarification of the different business center concepts, their characteristics, and how these characteristics can influence networking and knowledge sharing of users. Therefore, the aim of this thesis is:

To identify business center concepts and to analyze the influence of characteristics of these business center concepts on networking and knowledge sharing behavior between users of business centers.

To achieve this aim, the following research questions will be examined:

1.   Which types of business center concepts can be identified and how do they differ from each other?
2.   What is the influence of physical and non-physical aspects of business centers on networking and knowledge sharing behavior?
3.   At which locations inside business centers does specific networking and knowledge sharing behavior take place?

1.3 Intended contributions

Although business centers have become an important sector of the property market and several new business center concepts emerged, empirical research on this topic is still limited. Many studies analyzed knowledge sharing behavior within an organization (e.g., Hoadley and Pea, 2002; Berends et al., 2014) and the influence of the physical work environment on this behavior (e.g., Appel-Meulenbroek et al., 2017; Kastelein, 2014). Other studies focused on knowledge sharing between organizations on a global scale, in a region or on a campus. However, research on networking and knowledge sharing between organizations at the scale of a business center is still lacking.

Specifically in business centers, where organizations share workspaces and facilities, more research is needed on inter- and intra-organizational networking and actual knowledge sharing behavior. This thesis will give more insight into the business center sector and aims at identifying the business center concepts. Moreover, this thesis analyses how knowledge sharing between users is stimulated through the different physical and non-physical aspects of the business center concepts. The main contribution to existing studies is that not only networking and knowledge sharing within a large organization are analyzed, but also between and within organizations of different sizes, within the context of a business center, and through real-time experience sampling of activity data.

Results of this thesis will help real estate owners and developers to make well-informed decisions about the type of business centers that they want to develop or invest in. Understanding of networking and knowledge sharing behavior within and between organizations in business centers is important for designing optimal interactive work environments. This information could help to attract and retain more tenants.

For users of business centers, results of this thesis are also important to get more insight in which factors of the physical work environment could contribute to their knowledge sharing behavior and on how to stimulate knowledge sharing behavior of their employees at work. In addition, results can contribute to a better alignment between organizations and their Corporate Real Estate (CRE) strategy. Based on the results of this thesis, organizations can make a better selection for suitable accommodation to add value to their organization through networking and knowledge sharing.

Finally, results can be used by national and local governments to steer on regional development of business areas and preferred business center concepts, as one of the urban policy goals of many cities across the world is to attract and retain highly-skilled people and creative entrepreneurs (Smit, 2012). In addition, one of the key priorities of the European Union is to promote small and medium-sized enterprise (Costa-David et al., 2002).

1.4 Research design

The following sections will outline the research design of this dissertation. First, the philosophical basis for the research will be discussed based on the research onion model by Saunders et al. (2009). Next, the research approach of this dissertation will be discussed.

1.4.1 Research philosophy

The aim of this thesis is to identify different types of business center concepts and the characteristics that add value for networking and knowledge sharing behavior of users. The research onion model is used as an essential and helpful model for selection the appropriate research approach and methodology to systematically solve the research problem (see Figure 1).
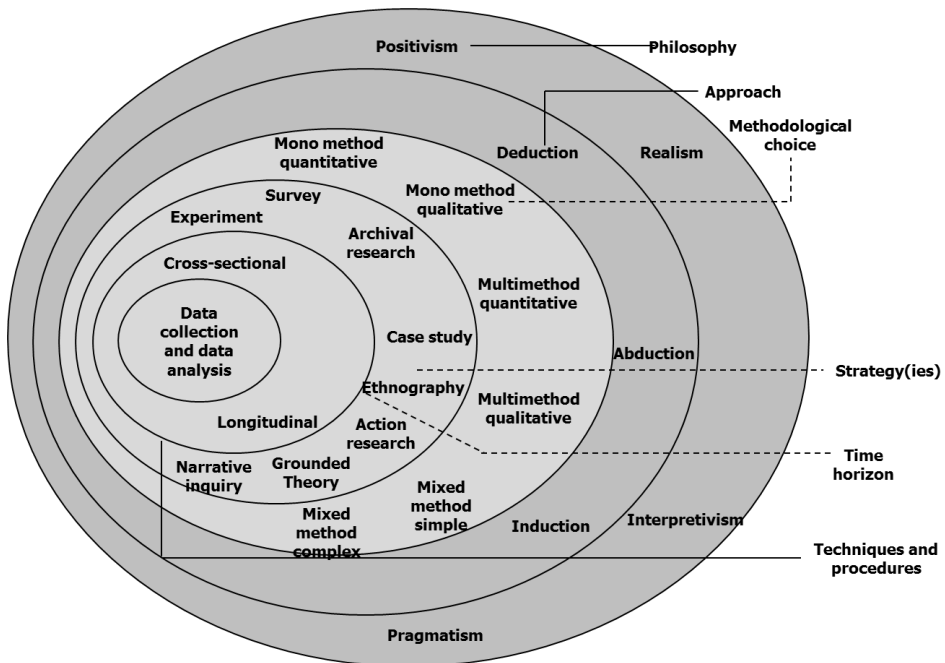
Figure 1. Research onion model (Saunders et al., 2009)

Four key research paradigms can be classified, namely positivism, realism, interpretivism and pragmatism (i.e., the outer layer of the research onion). A paradigm could be defined as a basic set of beliefs or worldview that guides research action or an investigation (Guba and Lincoln, 1994), which has implications for decisions with regard to the research design that is coherent with the research objective and research questions (Kivunja and Kuyini, 2017).

First, an important component of the positivism approach is that existing theory is used to develop hypotheses that will be tested during the research process. Another important aspect of this approach is that the research undertaken is purely based on facts and is independent of the interpretations and values of the researcher (Saunders et al., 2009; Wilson, 2010). Therefore, it mainly depends on quantitative methods and inferential, descriptive, experimental and simulative techniques to examine or test causal relationships among variables (Najmaei, 2016).

Next, philosophic realism in general is "the view that entities exist independently of being perceived, or independently of our theories about them" (Phillips, 1987, p. 205). Two forms of realism can be distinguished, namely direct realism and critical realism (Saunders et al., 2009). Direct realism can be described as "what you see is what you get". On the other hand, critical realism argues that what we see is only part of a bigger picture (Saunders et al., 2009). So, there are underlying causes, structures, processes, and entities that cause specific outcomes. Common methodologies of the realism paradigm are mainly qualitative methods (e.g., case studies or convergent interviews) (Sobh and Perry, 2005).

The interpretivism paradigm emphasizes qualitative analysis over quantitative analysis (Myers, 2008). This approach focuses on understanding the meanings in human behavior and not to test causal relationships (Neuman, 2000). Therefore, humanistic qualitative methods and techniques and approaches such as ethnography, case-study, unstructured interviews or participant observation, are based on the paradigm of interpretivism (Najmaei, 2016).

Finally, the pragmatism paradigm emphasizes the research problem and uses all approaches available to understand the problem (Rossman and Wilson, 1985). Therefore, a mixed methods approach, which involves the collection and analysis of both quantitative and qualitative data, is often associated with the pragmatic paradigm (Creswell, 2003).

The next layer of the research onion relates to the two different approaches, namely the inductive (i.e., exploring data and generate new theory from them) and

deductive (i.e., develop a theoretical framework based on existing theory, which is tested using data) approach, which is followed by the layer of the actual research design (Saunders et al., 2009). The most inner layer of the research onion relates to the techniques and procedures of the data collection.

Overall, positivism and a deductive approach is adopted by this dissertation to form the underlying research philosophy, as this dissertation proposes to test existing theories (i.e., single-tenant offices) with data that is structured and measurable, which involves statistical hypothesis testing that leads to the further development of existing and new theory on knowledge sharing and networking in business centers. In the next section, the research approach will be described in more detail.

1.4.2   Research approach

The research approach of this PhD project is visualized in Figure 2. First, information on the different types of business center concepts (e.g., size, objective, target group, spaces, facilities and additional services), networking, knowledge sharing and the influence of the physical work environment is gathered through a literature review. This gives insight into the relevant variables that is analyzed subsequently in this thesis.

Next, data is collected on characteristics of business center concepts by means of a questionnaire among owners/managers of business centers in the Netherlands. The aim of this data collection is to show if the business center concepts defined by previous studies, also exist in the market and analyze their differences and similarities. Next, data is collected on networking and knowledge sharing in business centers by means of a questionnaire among users of business centers in the Netherlands. This will give more insight into the perceived networking and knowledge sharing behavior in business centers and the influence of several factors on this behavior. Finally, data will be collected on real-time face-to-face interaction patterns and thereby shared knowledge, using a web-based Experience Sampling Method (ESM). This data is used to analyze how and where networking and knowledge sharing in business centers actually takes place. It also gives more insight into more detailed information on networking characteristics (e.g., duration of interactions; scheduled in advance, intentional unscheduled visit, or initiated after coincidental visual contact; social or work-related interactions, activity of the interactions) and knowledge sharing behavior (knowledge shared, if knowledge can be documented or not, if it is new or existing knowledge and the type of knowledge).

Furthermore, advanced regression analyses and path analyses are used to analyze relationships between personal-, business center characteristics, and perceived networking and knowledge sharing. Finally, the relationship between characteristics of the business center and the actual knowledge sharing behavior between users are analyzed using a mixed multinomial logit model (MMNL), controlling for several personal- and work-related characteristics and face-to-face interaction characteristics.
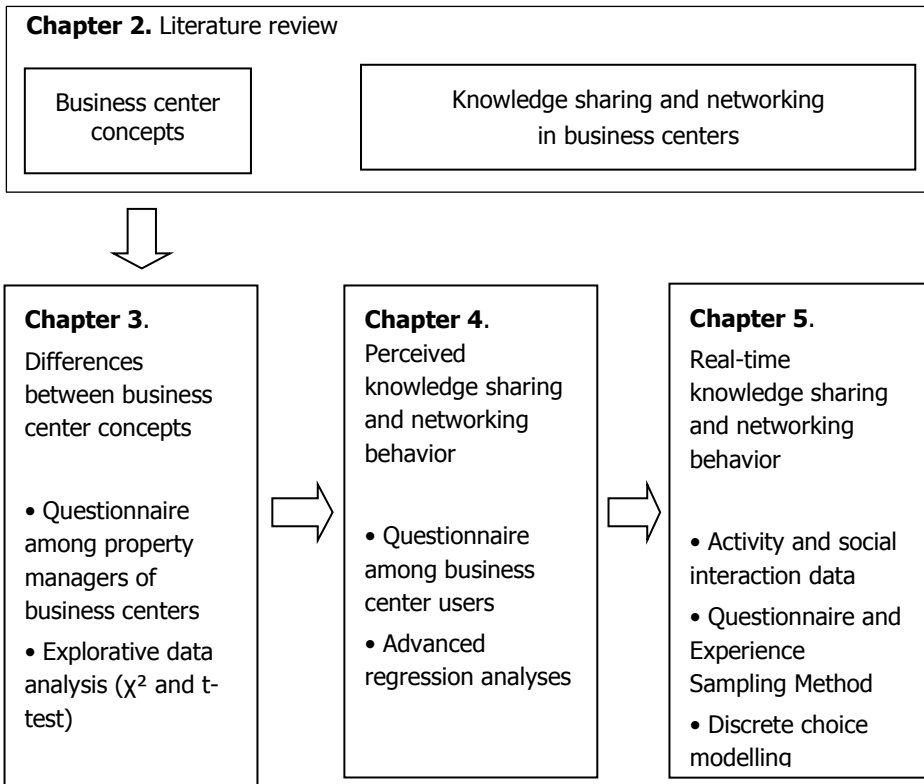
Figure 2. Research approach

1.5 Outline

Chapter 2 describes a review of the existing literature on business centers, networking, and knowledge sharing behavior and the influence of the physical work environment on this behavior. Next, the first research question is answered in Chapter 3. This chapter aims to analyze business center concepts and test, by an exploratory data analysis, if the existing classifications indeed imply significantly

different concepts. Data is collected among owners/managers of 139 business centers in the Netherlands. Results of this study give insight into the business center market, the existing business center concepts and (dis)similarities between the concepts. Chapter 4 answers research question 2 and aims to analyze the influence of physical and non-physical aspects of business centers on perceived networking and knowledge sharing behavior. A questionnaire is designed to capture information about demographics and personality, the use of services in business centers, the physical work environment and networking and knowledge sharing behavior. Data is collected among 268 users of 53 business centers in the Netherlands. First, a path model is estimated to analyze the effects of non-physical characteristics (i.e., services offered by the business center) on perceived networking and knowledge sharing behavior, controlling for demographics and personality. Next, results are presented of a path analysis that is estimated to analyze the effects of the physical work environment on perceived networking and knowledge sharing behavior. This study contributes to the knowledge gap on the relation between the physical work environment and knowledge sharing between organizations at the scale of a business center, which was still missing in previous research. Finally, a seemingly unrelated regression analysis is used to focus on the perceived sharing of the different types of knowledge. Results of this study provide new insights in particularly about which types of shared knowledge are influenced in which way by business center characteristics. Chapter 5 answers research question 3 and focuses on analyzing real-time face-to-face interaction and knowledge sharing patterns in business centers. A mixed multinomial logit model (MMNL model) is estimated to analyze the location choice for different types of interactions and knowledge sharing. Also, a MMNL model is tested to analyze the influence of the physical work environment on the choice of whether, where and what type of knowledge is shared, controlling for several personal- and interaction characteristics. The analyses are based on data collected using Experience Sampling Method (ESM) among 100 users of seven business centers in the Netherlands. Results of these analyses provide organizations with new insight on which locations in business centers are important for employees to interact and share knowledge with others. Finally, Chapter 6 concludes this thesis with a discussion of the results and their implications for practice and theory. Recommendations for further research are also included.

2

Literature review

This chapter discusses literature on business centers and networking and knowledge sharing behavior. First, we discuss business center concepts and their characteristics defined by previous studies. Next, a review of the relevant literature on knowledge types, networking and knowledge sharing behavior is given followed by a discussion of relevant literature of the influence of the physical work environment on knowledge sharing behavior. Finally, this chapter ends with a conclusion.

2.1 Business center concepts

This section provides a review of the existing literature on the different types of business center concepts and their characteristics. The first section gives a short introduction of business centers. Second, the different types of business centers are described based on existing literature. Finally, the conclusion defines a list of variables, which according to the literature are important aspects in order to classify the different business center concepts.

2.1.1 Introduction

The number of business centers increased substantially since the 1990s (Bröchner et al., 2004). Due to the economic crisis and thereby the high vacancy rates of single tenant offices, many offices were redeveloped into business centers (Lokhorst et al., 2013). In addition, due to the decreasing need of workspace, the increasing need for flexibility and affordable office space, many organizations are increasingly looking for an office space in a business center (Gibson, 2003).

Van den Berg and Ritsema (1982) described a business center as a collection of a number of spaces with possible certain common facilities that show a spatial coherence and which is offered by a management entity to multiple organizations. A later description of Calder and Courtney (1992) is quite similar. They characterize a business center as a number of relatively small spaces at a single location, which are offered on a short-term flexible rent and with some common services. In this study a business center is defined as:

'A building with a number of spaces and possibly some common facilities and/or services, which are offered to multiple organizations'.

Currently, there is no clear understanding of the different types of business center concepts. Some of the existing literature classified business centers into subgroups. For example, Calder and Courtney (1992) provided a first overview of the size and shape of the business center market in the United Kingdom based on the Tavistock Business Centre Survey. About 1000 business center operators in the UK were asked to fill in a mailed survey on detailed aspects of the business centers (e.g. on the services, sizes of the centers, staffing levels, marketing techniques and types of occupancy agreements) and a total of 165 business center operators responded. Based on the results of this survey, Calder and Courtney (1992) determined three different types of business centers namely, serviced offices, commercial centers and managed workspaces.

A later classification of business center concepts is determined by Van den Berg and Stijnenbosch (2009). They distinguished the different concepts based on size, location, facilities, additional services, ownership and target group. Van den Berg and Stijnenbosch (2009) determined incubators, business centers with a low service level, serviced office centers, public business centers, small private business centers and large private business centers. According to this classification, Ketting (2014) distinguished three types of business center concepts namely, incubators, serviced office centers and business centers. The different types of business centers (business center with a low service level, public business center, small private business center and large private business center) of Van den Berg and Stijnenbosch (2009) were merged in one concept 'business center'. Thus, all authors described serviced office centers, incubators (managed workspaces) and regular business centers (commercial business centers). Also new concepts have emerged based on these types of business center concepts (Laterveer, 2011). One of these concepts is a 'coworking office', which offers a shared work environment for mainly freelancers and small enterprises (e.g. Moriset, 2013; Uda, 2013; Huwart et al, 2012; Parrino, 2013). These offices are focused on stimulating interactions between organizations (Parrino, 2013). The next sections describe the four different types of business center concepts.

2.1.2   Regular business centers

Calder and Courtney (1992) defined regular business centers as commercial centers, which offer office spaces, and some regular common services that are normally found in multi-tenant property (e.g., security or cleaning). Van den Berg and Stijnenbosch (2009) further divided the category of regular business centers into business centers with a low service level, public business centers, large private business centers and small private business centers. This suggests there is not one clear typology of a regular business center. However, the main objective of these business centers is to offer office space, and some shared facilities or services (e.g., reception, or a conference room). These regular business centers offer office space to a wide range of businesses, such as large enterprises, medium-sized enterprises, small enterprises, start-up enterprises or freelancers. The first business centers, that provided office space, and a small set of shared services, appear to have shifted to business centers with a variety of shared services, facilities, and support services (serviced offices) (e.g., Troukens, 2001; Bruneel et al., 2010). However, many regular business centers remain that only offer office space and some facilities or services. There is hardly any research into this business center concept.

2.1.3   Serviced offices

The serviced office market experienced a rapid growth over the past decades (Harris, 2015). The demand for office space shifted from a demand for only office space to a demand for more flexible and adaptable office space with more support services and managed technology (e.g., teleconferencing, broadband access, web conferencing, or a virtual assistant) (Troukens, 2001). There are various definitions of a serviced office. Van den Berg and Stijnenbosch (2009) suggested that serviced offices are only available for large enterprises which are financially healthy (because of the high amount of services) and which are looking for flexible accommodation. On the other hand, Ketting (2014) suggested that serviced offices are aimed at providing flexible accommodation for freelancers. Gibson and Lizieri (1999, p.4) defined a serviced office as 'a fully fitted space on a pay-as you-use arrangement with a range of IT and secretarial services'. Later, Ellis (2013) suggested that serviced offices offer fully equipped and staffed office space on a short-term lease, with shared facilities (e.g., a reception, break areas, kitchens and IT services). The above described definitions on serviced offices suggest that there are several types of serviced offices (e.g., WTC Amsterdam or Regus offices). Overall, a serviced office includes four important elements, namely shared office accommodation, business

services, facilities and managed technology (e.g., video conferencing, broadband access or teleconferencing) (Peltier, 2001). Serviced offices could be used by different types of tenants (e.g., start-up enterprises, freelancers, businesses entering a new market, virtual workers, flexible 'corporate' worker or a flex worker between appointments) (Laterveer, 2011). An important benefit of serviced offices is that tenants can fully concentrate on their core business (Price and Spicer, 2002). Troukens (2001) suggested that users can benefit from serviced offices through physical, functional and financial flexibility, the ability to work on the most appropriate location, managed technology and reduced costs (shared services/facilities). However, serviced offices do not have the aim to support interaction, collaboration, and networking among tenants (Fuzi et al., 2015).

2.1.4   Coworking offices

The idea of a coworking office was first derived from a serviced office by Brad Neuberg in the mid-1990s, when he created the 'Spiral Muse coworking community' in San Francisco (Spinuzzi, 2012; Van Meel and Brinkø, 2014). In this type of community, people share facilities or services and participate in activities together. The main difference between serviced offices and coworking offices is that serviced offices do not aim to create a collaborative atmosphere. Currently, there are more than 3.500 coworking offices around the world with more than 160.000 members (Global Workspace Association, 2014). Coworking offices have become a global phenomenon (Sykes, 2014; Moriset, 2014) and are still growing in popularity, through changes in technology, attitudes towards work and the 'new shared economy' (Green, 2014).

Coworking offices offer a community-driven environment with services and activities that stimulate relationships and collaboration among tenants (Fuzi et al., 2014; Sykes, 2014). A coworking office is not just a physical space, but it is a community of likeminded people with trust and collaboration among tenants (Huwart et al., 2012). Van Meel and Brinkø (2014) agreed with this definition and suggested that a coworking place stimulates a sense of community, collaboration and synergies among people. Coworking increases knowledge sharing between entrepreneurs. Entrepreneurs are more productive in coworking offices and collaboration in coworking spaces could lead to synergies among them (Deijl, 2011).

Fuzi et al. (2014) described a coworking office as a work environment for freelancers and other location-independent professionals'. Coworking offices are not only attractive for freelancers, contractors and small enterprises, but also to larger

enterprises that need a temporary office space (Sykes, 2014). It is difficult to categorize coworking offices because of the large variety of spaces, the complexity of the multiple potential combinations of people, space, networks, industry combinations, sponsorships and structures.

2.1.5 Incubators

An incubator can be defined as a property based initiative that provides business support services (Ratinho, 2011) and a network of individuals and organizations (Hackett and Dits, 2004). Peters et al. (2004) suggested that an incubator entails a change from a business center only offering office space and facilities to a business center that offers a variety of services specifically to start-up enterprises. Bruneel et al. (2010) generalized three generations of incubators based on existing literature. The first generation, 'the generation of infrastructure', started in the 1950s. The core value of these incubators was providing low cost office space, and a small set of shared services (e.g., secretarial services, copy and fax, reception, telephone answering), similarly, as a regular business center. The next generation of incubators started in the mid-1980s and was focused on helping new companies to develop their experience and skills through business support services (e.g., coaching and training). Finally, the last generation started in the mid-1990s and was called 'the generations of networks'. This generation provides access to external networks (e.g., potential customers, suppliers, partners, and investors). It provides learning opportunities and allows start-ups to grow faster. Bruneel et al. (2010) observed that the lack of financial capital, experienced management teams and capabilities often inhibits the survival and growth of start-up enterprises. The main objective of a business incubator is, therefore, not to offer office space, shared facilities and services, but to accelerate the successful development of start-up enterprises and support them in the development of innovative products (e.g., Lesáková, 2012; Aernoudt, 2004; Peña, 2004). As such, Peters et al. (2004) argued that, besides, supporting and helping start-up enterprises, incubators should promote local job creation, technology transfer and economic development. Mian (1996) suggested that the key services of an incubator are shared office services, business assistance, access to capital, business networks and rent breaks. Business support services, such as business advice, entrepreneurial training and assistance services are one of the most important factors for the successful development of enterprises (Al-Mubaraki and Busler, 2011; Peña, 2004; Mian, 1996). Incubators can vary depending on the

type of property, on capacity, the target group, organizational structure, strategy, facilities, and services (Lesáková, 2012; European Commission, 2002).

Table 1 gives an overview of the characteristics of the different business center concepts. Whereas previous studies have identified these characteristics (e.g., objective, prime target group, office space, work mode, atmosphere, facilities/services) and types of business center concepts (i.e., incubators, business centers, serviced offices and coworking offices), they also observed many possible variations within each type of business center concept. Therefore, the question arises whether these 4 types of business center concepts form a clear and valid taxonomy that reflects the structure of this sector.

Table 1. An overview of business center concepts

	Business center	**Serviced office**	**Coworking office**	**Incubator**
Objective	Offer office space	Offer flexible office space, business services, facilities and managed technology (e.g., Peltier, 2001)	Creating a work community. Stimulate a sense of collaboration and synergy (e.g., Van Meel and Brinkø, 2014; Deijl, 2011)	Supporting and facilitating start-ups. Promote local job creation, technology transfer and economic development (e.g., Peters et al., 2004; Lesáková, 2012)
Tenants (Prime target group)	A wide range of businesses	SMEs, freelancers (e.g., Laterveer, 2011; Ketting, 2014)	SMEs, freelancers, large enterprises and location-independent professionals (e.g., Sykes, 2014; Fuzi et al., 2014)	Start-up enterprises (e.g., Ketting, 2014; Bruneel et al., 2010)
Tenants/ Atmosphere	Formal/ informal	Formal (e.g., Van Meel and Brinkø, 2014)	Informal (e.g., Van Meel and Brinkø, 2014)	Formal/ informal
Facilities/ services	Low service level, some shared facilities or services (e.g., Calder and Courtney, 1992; Van den Berg and Stijnenbosch, 2009)	Business services (e.g., accounting, administration, word processing), IT services and secretarial services (e.g., reception, mail, fax, email, telephone service) (e.g., Troukens, 2001)	Business services, IT services, secretarial services and access to networking events and workshops (e.g., Deijl, 2011)	Business services, IT services, secretarial services, access to networking events, workshops and business support services (e.g., Chen et al., 2006; Mian, 1996)
Spaces	Separate units	Separate units (e.g., Van Meel and Brinkø, 2014)	Open plan spaces (e.g., Van Meel and Brinkø, 2014)	Separate units/ open plan spaces

2.2 Networking and knowledge sharing

This section provides a review of the relevant literature on knowledge, networking and knowledge sharing behavior. It is generally believed that knowledge sharing behavior can be studied from a social network perspective (e.g., Tsai, 2001; Borgatti and Halgin, 2011; Harisson and Hu, 2012; Aalbers et al., 2014). Hansen (2002) suggested that research on knowledge sharing behavior and synergies among organizations should aim for new perspectives that combine the concepts of networking and knowledge sharing behavior. Organizations are social communities and networks are therefore important for organizations to get access to knowledge and resources (Marouf, 2007). Moreover, social networks (formal and informal networks) can provide links to new sources of knowledge (Argote and Ingram, 2000). In this section, first a short introduction of the definition of knowledge is given. Second, a review of existing literature on networking and knowledge sharing behavior is given, followed by a section on possible factors that could influence this behavior.

2.2.1 Knowledge

It is recognized that knowledge is the most important resource of organizations (Ipe, 2003; Van den Hooff and Hendrix, 2004), especially in today's 'knowledge economy' (e.g., Yao and Fan, 2015). Knowledge sharing therefore, increasingly received attention of organizations. It is important that organizations not only acquire knowledge within the organization but also acquire knowledge from other organizations. Organizations could benefit and learn from each other's knowledge, which eventually could lead to creating new knowledge (Marouf, 2007).

Knowledge of organizations exists at the individual, group, department, division and organizational level (Ipe, 2003). Although knowledge is based on data and information, it cannot be considered separately from the people who create, use and exchange knowledge (Alipour et al., 2011). Knowledge could, therefore, be shared through, and is dependent of (formal or informal) social interactions between individuals (Ipe, 2003). Alavi and Leidner (2001, p.109) defined knowledge as:

'*information possessed in the mind of individuals: it is personalized information (which may or may not be new, unique, useful, or accurate) related to facts, procedures, concepts, interpretations, ideas, observations, and judgments*.'

This definition is used by several authors (e.g., Stenmark, 2001; Hansen and Avital, 2005; Wei, 2007; Chen et al., 2010; Yu et al., 2010). It shows the importance of the role of individual social actors in sharing knowledge. However, others have argued that knowledge is not only personalized information, but also public information (Nonaka, 1994; Kastelein, 2014).

2.2.2 Typology of knowledge

Several studies tried to categorize knowledge into different forms or types. For example, the commonly used distinction of individual knowledge by Polanyi (1958), namely between explicit- and tacit knowledge, is widely used in knowledge (sharing) research (e.g., Nonaka et al., 2000; Seidler-de Alwis and Hartmann, 2008; Keyes, 2008). Explicit knowledge (i.e., codified) can be deposited, managed, transmitted and stored. This type of knowledge can be found in for example books, newspapers, magazines, television, and Internet. It can be shared in the form of data, scientific formulas, manuals, or patents. Tacit knowledge (non-codified) can be described as personal knowledge and arises from for example procedures, commitment, values, and emotions. Tacit knowledge is, because of its personal character, difficult to formalize and communicate (Nonaka, 1994). Tacit knowledge is acquired by sharing experiences, observation, or imitation (Seidler-de Alwis and Hartmann, 2008).

Tacit and explicit knowledge are complementary, new knowledge is formed by the interactions between explicit and tacit knowledge (Nonaka et al., 2000). Collins (2007) discussed that some tacit knowledge cannot be made explicit and distinguished tacit knowledge in three types, namely relational tacit knowledge (RTK), somatic tacit knowledge (STK) and collective tacit knowledge (CTK). These knowledge types differ based on the level of explication of knowledge. First, RTK is the easiest to explicate. This is for example, learning a particular skill or crafts. Next, STK is more difficult to explicate. This type of tacit knowledge is related to the body. For example, learning to ride a bicycle or learning to swim. Finally, CTK is impossible to explicate, because it is dependent on culture, location, and context. In addition, experience is needed. CTK is for example, learning when it is appropriate to laugh.

Furthermore, knowledge can be individual (within a person's mind) or collective (knowledge of a group of people) (Nonaka, 1994; Kastelein, 2014). Bouzdine and Bourakova-Lorgnier (2004) made a distinction between explicit/individual knowledge, tacit/individual knowledge, explicit/collective

knowledge and tacit/collective knowledge. Marouf (2007) distinguished knowledge in a sort of similar way, namely:

- Public non-codified knowledge: general, work-related, context-free, depersonalized, verifiable through third parties and not documented in any form;

- Public codified knowledge: general, work-related, context-free, depersonalized, verifiable through third parties, documented in some form and written in the form of standard instruments (e.g., company reports and manuals);

- Private non-codified knowledge: personal or informal, context-specific, subjective, personally sensitive and not documented in any form (e.g., beliefs, viewpoints, insights, and experiences);

- Private codified knowledge: informal or personal, context-specific, personally, sensitive, and documented in some form (e.g., correspondence and personal notes).

Another common known distinction of knowledge types is presented by the I-Space (Information Space) model (Boisot, 1995), which is a conceptual framework for the analysis of knowledge (Boisot et al., 2005; Canals, 2002). Boisot (1995; 1998) distinguished four types of knowledge in the I-Space model, namely personal knowledge (undiffused and uncodified), common-sense knowledge (diffused and uncodified), proprietary knowledge (undiffused and codified), and public knowledge (diffused and codified) (see Figure 3). This model is developed to understand knowledge dynamics in organizations. By adding the concrete-abstract dimension, the I-Space model shows how knowledge is used and distributed in organizations (Qvortrup, 2006).

Blackler (1995) distinguished knowledge into embrained knowledge, embodied knowledge, encultured knowledge, embedded knowledge and encoded knowledge. Embrained knowledge is knowledge that is dependent on conceptual skills and cognitive abilities. Embodied knowledge is action oriented (practical knowledge developed in specific physical contexts, as in project work). Encultured knowledge is rooted in shared understanding developed through socialization. It refers to the process of achieving shared understandings. Embedded knowledge is knowledge which resides in systemic routines (subjective knowledge embedded in a context). Encoded knowledge is information conveyed by signs and symbols (knowledge that can be presented in manuals, books, websites etc.).
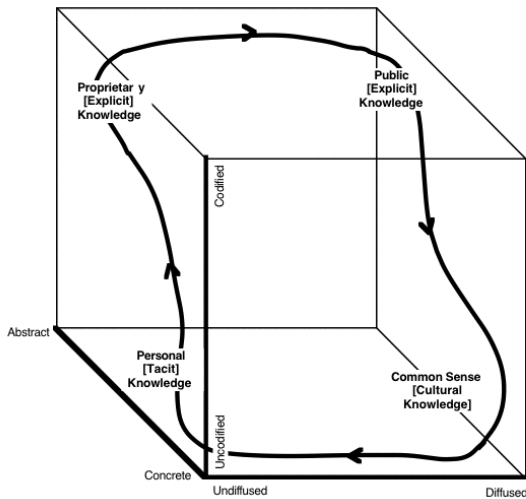
Figure 3. The movement of knowledge in the I-Space

(adapted from Boisot, 1998, p.59)

In summary, knowledge can be classified in a variety of different forms or types. The typology of knowledge constructed by Marouf (2007) is used in this thesis. This typology is an extension of the widely known distinction between tacit (non-codified) and explicit (codified) knowledge, which is more reflective to real-world situations. For example, not all codified knowledge is available for use and not all non-codified knowledge is private (Marouf, 2007). These different forms of knowledge are simple, easy to use in models and easy to explain to people in practical life (Mládková, 2014; Marouf, 2007).

2.2.3   Knowledge sharing

Knowledge sharing has become increasingly important for organizations (Ipe, 2003), because knowledge is a vital source for an organization's performance, innovative capabilities and sustainable competitive advantage (Wang and Noe, 2010; Ngah and Ibrahim, 2010). Nooshinfard and Nemati-Anaraki (2014, p. 243) described the goal of knowledge sharing as 'to create new knowledge by combining existing knowledge in new knowledge or to exploit the existing knowledge in a better way'. Knowledge sharing could have many benefits for organizations such as to strengthen innovation, to identify new business opportunities, to obtain resources, to increase customer satisfaction and to produce products and services of a higher quality

(Andriessen, 2006; Stam et al., 2014). De Vries et al. (2006) described knowledge sharing as:

'*a process in which individuals mutually exchange knowledge and jointly create new knowledge*.'

Some studies labelled knowledge sharing in a different way, such as 'knowledge transfer' (Van Wijk et al., 2008; Maurer, 2011; Chon et al. 2011), 'knowledge creation' (Nonaka and Takeuchi, 1995; Nonaka and Konno, 1998; Nonaka et al., 2006; Bathelt et al., 2004), or 'knowledge flows' (Monteiro et al., 2008; Gupta and Govindarajan, 2000; Dahl and Pedersen, 2004). Paulin and Sunison (2012) suggested that a common division between knowledge sharing and knowledge transfer is based on the level of analysis. Knowledge sharing is used more frequently in studies that focus on the individual level and knowledge transfer is used more frequently in studies that focus on the group, department and organization level (Paulin and Sunison, 2012). Knowledge creation refers to the knowledge sharing process (socialization externalization, combination and internalization) (Nonaka and Takeuchi, 1995). The concept of 'knowledge flows' is more frequently used in studies at a geographical level (e.g., clusters) (Becker and Knudsen, 2006). In this thesis, these three terms are considered as synonyms, when they are used by authors to indicate knowledge sharing between individuals.

Knowledge sharing is a process that involves two or more actors (donator and collector) and can occur through different media (e.g., face-to-face interaction, email or online chat) (Laihonen, 2014). There are four important aspects that describe and could influence knowledge sharing behavior between two or more actors (organization or individuals). First, it is important to know who shares knowledge with whom (actors). Next, what type of knowledge is shared (content) is important. Finally, the context in which knowledge is shared is important (context) and which medium is used to share knowledge (media) (Laihonen, 2014; Albino et al., 1999).

Previous knowledge sharing research described two types of knowledge sharing behavior, namely inter-organizational knowledge sharing (between organizations) and intra-organizational knowledge sharing (within an organization) (e.g., Van Wijk et al., 2008; Maurer, 2011; Nodari, et al., 2013). Many studies focus on knowledge sharing behavior within an organization. However, it is recognized that inter-organizational knowledge sharing behavior is more complicated than intra-organizational knowledge sharing behavior (Chen et al., 2006; Newell and Swan, 2000), but also highly important for organizations (Easterby-Smith et al., 2008).

Intra-organizational knowledge sharing

Knowledge sharing in organizations is highly dependent on the people who work in organizations, because they create, share and use knowledge (Ipe, 2003). Ipe suggested that knowledge sharing in an organization moves knowledge from the individual's level to the organizational level.

There are several models, frameworks and theories that describe the knowledge management process within an organization. The SECI model (Nonaka and Takeuchi, 1995) is one of the most well-known knowledge management models (e.g., Rai, 2011; Akehurst et al., 2011; Muina et al., 2002). This model is based on the theory that knowledge is created by individuals and then transmitted to the organization (Rai, 2011; Finley and Sathe, 2013). This organizational knowledge creation theory has been used in many studies, for example to explain organizational behavior, human resource management and leadership, innovation and technology management, strategic management, public administration and management information systems (Nonaka et al., 2006).
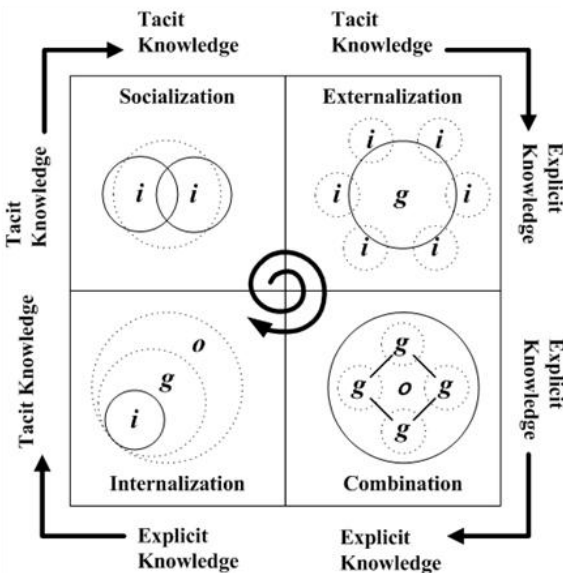

Figure 4. SECI model (Nonaka and Takeuchi, 1995; Nonaka and Konno, 1998)

Next, externalization is the process of converting tacit knowledge into explicit knowledge that is easy to understand. Combination is the process of converting

explicit knowledge into complex sets of explicit knowledge and is facilitated by large-scale databases and communication networks (Rai, 2011).

Finally, internalization is converting explicit knowledge into the organizations tacit knowledge (Nonaka and Takeuchi, 1995; Nonaka and Konno, 1998). The movement through these four modes forms a spiral (Nonaka and Takeuchi, 1995) as shown in Figure 4. Four modes were proposed in this model, by which new knowledge is created through combining or converting tacit and explicit knowledge, namely socialization, externalization, combination and internalization (Nonaka and Takeuchi, 1995). Socialization can be described as sharing tacit knowledge between individuals through joint activities.

Knowledge sharing occurs through different types of media such as face-to-face interaction, joint action, learning-through-doing, video conferencing, phone calls, emails, letters, memos, etc. (Bouzdine and Bourakova-Lorgnier, 2004). Kastelein (2014) analyzed the importance of channels (e.g., face-to-face meetings, formal planned meetings, Video Conferencing (VC), code reviews, writing/reading documentation, training/presentations, chat and telephone/phone conversations) for knowledge sharing within an organization. Face-to-face meetings, whiteboard area discussions, video conferencing and email were found to be the most important activities for knowledge sharing within an organization (Kastelein, 2014).

Appel-Meulenbroek et al. (2017) used the concept of moves, identified by Berends (2003), to analyze knowledge sharing of individuals within an organization. The five categories of moves that were analyzed are descriptions, actions, questions, proposals, and evaluations. Appel-Meulenbroek et al. (2017) defined these moves as knowledge sharing activities and focused only on face-to-face interactions. In addition, Yi (2009) made a distinction between four types of knowledge sharing types, namely between:

- Written contributions (e.g., submit documents and reports, published papers in company journals, magazines, or newsletters and keep others updated with important organizational information through online discussion boards)

- Organizational communications (e.g., express ideas and thoughts in organizational meetings, participate fully in brainstorming sessions, answer questions of others and share success stories that may benefit the company)

- Personal interactions (e.g., share experiences, share passion and excitement, have online chats with others to help them and keep others updated with important organizational information through personal conversation)

- Communities of practice (e.g., meet with community members (an informal network of people within organizations) to create innovative solutions, to share own experiences and practice on specific topics and support personal development of new community members)

Furthermore, Marouf (2007) described knowledge sharing behavior within an organization among different units. Knowledge sharing behavior was measured by asking employees the frequency to seek advice and/or a referral whenever they needed a certain skill or competency to assist them with their job (public non-codified knowledge), exchange documents (e.g., reports or financial statements) (public codified knowledge), sharing expertise in face-to-face meetings (private non-codified knowledge) and sharing expertise using emails or memos (private codified knowledge). The distinction of Marouf (2007) will be used in this thesis, because it refers to the type (form and ownership) of knowledge that is shared.

Some studies analyzed the influence of knowledge sharing behavior on performance outcomes. For example, Ngah and Ibrahim (2010) studied the impact of knowledge sharing on organizational performance of SMEs. Organizational performance was defined as 'comparing the expected results with the actual ones, investigating deviations from plans, assessing individual performance and examining progress made towards meeting the targeted objectives' (Ngah and Ibrahim, 2010, p.503). Findings of this study suggested that knowledge sharing positively affects organizational performance. Golabi et al. (2013) also studied the effect of knowledge management practices on organizational performance of SMEs, using structural equation modelling (SEM). Five knowledge management practices were distinguished namely knowledge creation, acquisition, sharing, storage, and implementation. Organizational performance was measured by five items: productivity, financial performance, staff performance, innovation, work relationships and customer satisfaction. All knowledge management practices were found to positively influence organizational performance. Similar results were found by the study of Zack et al. (2009). Results of this study show a direct relationship between knowledge management practices and organizational performance. However, no direct relation was found between knowledge management practices and financial performance. Thus, with regard to financial performances opposite results were found compared to the study by Golabi et al. (2013).

Inter-organizational knowledge sharing

Knowledge between organizations can be shared downstream (with customers), upstream (with suppliers, universities and other organizations) or horizontal (with competitors) (Becker and Knudson, 2006). Easterby-Smith et al. (2008) suggested that knowledge sharing between organizations is more complex than knowledge sharing within an organization, because of different boundaries, cultures, and processes. However, organizations could improve their knowledge and innovative capabilities by sharing knowledge across organizations (Easterby-Smith et al., 2008). Nodari et al. (2013) suggested that the purpose of inter-organizational knowledge sharing is 'to promote competitive advantage by sharing benefits with other companies'.

A growing number of studies focus on inter-organizational knowledge sharing. Inter-organizational knowledge sharing can be described as a process of mutual learning between organizations (Nodari, et al., 2013), which consists of learning between individuals from different organizations and the conversion of individual learning into organizational learning (Chen et al., 2006). Huggins et al. (2012) suggested that inter-organizational knowledge could flow through alliance networks (e.g., formalized collaboration and joint ventures) and contact networks (e.g., informal relationships between organizations and other individuals).

Several studies on inter-organizational knowledge analyzed knowledge sharing through alliances. Strategic alliances involve an alliance of two or more partner organizations with partner co-operation and control (Bhatti, 2011). Bhatti implied that complementary knowledge sharing is an important basis of alliances, as it provides opportunities for different organizations to work together. Soekijad and Andriessen (2003) suggested several important conditions (strength of the relationship, mutual trust, the need for co-operation, motivation, (relative) absorptive capacity, and accessibility) for learning and knowledge sharing processes within alliances to take place.

Knowledge sharing through informal social networks (contact networks) also received attention. For example, Østergaard (2009) compared knowledge flows through informal social contacts between inter-firm contacts (informal contacts with employees in other firms) and university-industry contacts (informal contacts with university researchers). Results show that inter-firm informal contacts appear more frequently than university-industry contacts. However, these results depend on the type of industry. In addition, the results showed that although knowledge is diffused

through informal contacts, these are used less frequently to acquire knowledge then formal contacts (Østergaard, 2009). Also, Dahl and Pedersen (2004) studied knowledge sharing in industrial clusters. Findings of this study suggest that knowledge flows through informal contacts in industrial clusters. Chen et al. (2006) analyzed the perceived need of SMEs to be involved in inter-organizational knowledge sharing activities. SMEs were found to have the greatest need to be involved in 'establishing strategy to obtain information from customers, suppliers, competitors and other organizations', 'use information from competitors to improve business performance', 'use information from customers, suppliers, or other organizations to improve business performance' and 'learning through customer-supplier partnership' (Chen et al., 2006).

2.2.4   Networking

Several researchers defined a social network as (e.g., Mitchell, 1969, p.2; Tichy et al., 1979, p.507; Seufert et al., 1999; Ten Kate et al., 2010):

'*a specific set of linkages among a defined set of actors (individuals, groups, organizations or communities), with the additional property that the characteristics of these linkages as a whole may be used to interpret the social behavior of the actors involve.*'

Networks are defined by actors and their linkages. These linkages (relations) between actors are important for knowledge sharing (Wasserman and Faust, 2008). Seufert et al. (1999) suggested that these relationships can be categorized based on the content (e.g., products or services, information, emotions), form (e.g., duration and closeness of the relationship) and intensity (e.g., interaction-frequency).

Several studies analyzed the relations between network activities and the performance of businesses. For example, Terziovski (2003) analyzed the relationship between networking and business excellence. They found that networking practices could have a positive effect on business excellence. In addition, Chell and Baines (2000) found that active networking could lead to business growth and vice versa, business growth could lead to more active networking. Customers and other business owner-managers were found to be the most important sources for new information. Similar results were found by the study of Watson (2007), who suggested that networking could increase business survival and business growth.

Furthermore, Maurer (2011) analyzed the influence of intra-organizational social capital (i.e., number of ties, tie strength and trust) on organizational

performance (growth and innovation performance) through knowledge sharing. A positive relation was found between tie strength and knowledge sharing. No relation was found between the number of ties, trust and knowledge sharing.

Networks are also important for explaining knowledge sharing behavior. Knowledge sharing mostly appears through social networks in formal and informal settings (Heerwagen et al., 2004). Wang et al. (2010) suggested that most (tacit) knowledge is shared through social interactions between individuals. Moreover, Ngah and Jusoff (2009) stated that knowledge sharing behavior in SMEs is most effective through informal face-to-face social interactions and is very important for SMEs to be creative and innovative. Thus, interacting and the use of network ties are needed for knowledge sharing behavior among individuals and groups (Marouf and Doreian, 2010). Easterby-Smith et al. (2008) argued that social ties could soften cultural differences between organizations and stimulate knowledge sharing behavior.

Network properties

Two types of interactions in a work environment can be distinguished namely business interactions and social interactions (Marouf, 2007). Knowledge is mostly shared through social interactions between people (Wang et al., 2010). On the other hand, Marouf (2007) found that business interactions appear more frequently than social interactions in a work environment. Thus, probably in a business center users probably have more business than social interactions.

Dodd and Patra (2002) described networks of entrepreneurs as relationships which are important resources for their activities and could arise through membership of an informal organization, links with suppliers, distributors and customers or the utilization of social contacts (e.g., acquaintances, friends, family and kin). Greve and Salaff (2003) suggested that networks could have some useful properties (size, position and relationship structure) for entrepreneurs. First, the size of the network, enlarging the network could lead to (more) information and resources from others. Next, position in the network refers to that a short path could lead to more access to knowledgeable others. Finally, relationship structure refers to the fact that social contacts could have different types of relations or interactions.

Strength of network ties

Many researchers recognized that the strength of ties could also affect knowledge sharing (e.g., Reagans and McEvily, 2003; Levin et al., 2004). Xerri and Brunetto (2010) described strong ties as relationships with a high level of interaction,

emotional intensity, and reciprocity, such as relationships with family members, close friends or close colleagues. Weak ties were described as relationships with a low level of interaction, emotional attachment and reciprocity, such as acquaintances, friends of friends and distant colleagues. Tie strength is mostly analyzed by the frequency of interactions and the closeness of the relationship (Marouf, 2007).

The theory of Granovetter (1983) on the 'strength of weak ties' is widely known. Granovetter (1983) suggested that weak ties are more important for sharing new information, because weak ties provide access to new information and resources beyond the social circle. Strong ties could hinder new information, and therefore probably also knowledge sharing behavior, because stronger ties have more similarities. Ramasamy et al. (2006) suggested that when the strength of the relationship between two organizations is low, knowledge sharing still occurs. Also, Meijs et al. (2010) suggested that weak ties could provide the addition of new knowledge to an organization. Levin et al. (2004) found that (trusted) weak ties provided the most useful (new) knowledge. On the other hand, weak ties are mostly of short duration and appear less frequently (Chell and Baines, 2000). A higher frequency (or longer duration) of interactions could lead to stronger ties and eventually to more knowledge sharing behavior (Van Wijk et al., 2008; Narges and Farhad, 2010), but it could not lead to new knowledge (Levin et al., 2004).

Thus, it is expected that knowledge sharing is influenced by several network characteristics. First, it is recognized that the size of the network and structure (i.e., type of network relations, namely if it is a business or a social relation) and position in a network could be important for entrepreneurs to share knowledge. Also, the strength of ties (frequency of interactions, duration and closeness of the relation) between actors could influence knowledge sharing behavior. Weak ties are more important for sharing new knowledge than stronger ties. However, we also expect that people who are more willing to share knowledge will also have a larger network and more frequently interact with others. These network characteristics will be analyzed in this thesis. The position in the network will not be taken into account, because it is difficult to measure the whole network in the business center, which is not that relevant in this thesis. Also, the closeness of the relation will be analyzed, which gives some information about the position in the network.

2.2.5 Factors influencing networking and knowledge sharing behavior

Besides the content, medium and actors, the context should also be considered when analyzing networking and knowledge sharing behavior in the workplace (business center) (Suckley and Dobson, 2014). An increased number of studies analyzed factors that could influence knowledge sharing behavior. It is recognized that knowledge sharing could be influenced by individual and organizational context (e.g., Riege, 2005; Van den Hooff and Hendrix, 2004; Van den Hooff and De Ridder, 2004). The following sections describe the literature review on individual and organizational context that could influence knowledge sharing and/or networking behavior.

Individual context

It is generally believed that knowledge sharing is dependent on the role of individuals in knowledge sharing because individuals generate knowledge and serve as receptor of knowledge in an organization (Okyere-Kwakye and Nor, 2011). Also, it is recognized that demographic factors of individuals can influence networking and knowledge sharing behavior (e.g., Meijs et al., 2010; Klyver and Grant, 2010).

Table 2 shows an overview of existing literature on the influence of different individual factors on networking and knowledge sharing behavior, and whether these factors influence inter-organizational or intra-organizational knowledge sharing and/or networking behavior. As can been seen, most studies describe the relation between individual factors and knowledge sharing or network behavior within an organization (intra-organizational) (e.g., Gharanjik and Azma, 2014; Lin, 2007; Klyver and Grant, 2010; Levin and Cross, 2004). Several studies describe knowledge sharing behavior in combination with social networks (e.g., network ties or social structure) (e.g., Van der Capellen et al., 2011; Chow and Chan, 2008; Inkpen and Tsang, 2005) and some focus specifically on networking behavior (e.g., Alhammad et al., 2009; Klyver and Grant, 2010). Overall, it is recognized that networking and knowledge sharing behavior is influenced by personality and demographic factors (e.g., gender, age, income and education level). The following sections describe studies on individual factors in more detail.

Table 2. An overview of studies that focus on the effect of individual factors (KS= Knowledge sharing and N=Networking)

	Organizational level		Behavior	
	Inter	Intra	KS	N
Personality				
Agreeableness, conscientiousness, openness, neuroticism (Gharanjik and Azma, 2014)		X	X	
Agreeableness, openness and conscientiousness (Matzler et al., 2008)		X	X	
Agreeableness and conscientiousness (Gupta, 2008)		X	X	
Agreeableness, openness and extraversion (Wolff and Kim, 2011)	X	X		X
Flexibility, tolerance for uncertainty, confidence, expertise and independence (Meijs et al., 20102)		X	X	X
Departmental commitment and enjoyment in helping others (Van der Capellen et al., 2011)		X	X	X
Willingness to share knowledge (Lam and Lambermont-Ford, 2010)		X	X	
Eagerness and willingness to share knowledge (Van den Hooff and Hendrix, 2004)		X	X	
Intention to share knowledge (Narges and Farhad, 2010)	X		X	
Confidence and pleasure in sharing knowledge (Lin, 2007)		X	X	
Shared goals (Chow and Chan, 2008)		X	X	X
The ability to share knowledge (Hinds and Pfeffer, 2003)		X	X	
Motivation, values, attitude, moods, emotions, skill and roles (Van den Brink, 2003)		X	X	
Demographic factors				
Gender, age, income and education level (Zengyu et al., 2013)		X		X
Gender, age and experience (Meijs et al., 2010)		X	X	X
Gender differences (Klyver and Grant, 2010)		X		X
Gender differences (Alhammad et al., 2009)		X	X	
Gender, age, education level and position grade (Ismail and Yusof, 2009)		X	X	
Age, work experience, organizational tenure, job tenure (Pangil and Nadurdin, 2008)		X	X	

Personality

Several studies analyzed the influence of personality on knowledge sharing behavior (e.g., Matzler et al., 2008; Gupta, 2008; Van den Hooff and Hendrix, 2004). It is recognized that the Big Five Factor Model is a valid model for describing individual's personality. The five factors of the Big Five taxonomy are extraversion,

agreeableness, conscientiousness, openness and neuroticism. Gupta (2008) analyzed the role of individual's personality on knowledge sharing behavior. Findings of this study show that individuals who are more agreeable and conscientious, are more involved in knowledge sharing activities. Another study analyzed the influence of the five personality traits on the willingness of employees to share knowledge (Gharanjik and Azma, 2014). Gharanjik and Azma (2014) found a relation between agreeableness (positive), conscientiousness (positive), openness (positive), neuroticism (negative) and the willingness of employees to share knowledge. Moreover, Matzler et al. (2008) found similar results, namely people who score higher on agreeableness, openness and conscientiousness, are more willing to share knowledge. However, they did not find a relation between openness, neuroticism and willingness to share knowledge. Furthermore, Van den Hooff and Hendrix (2004) analyzed the relationship between individual's willingness, eagerness and receiving or donating knowledge. Findings suggest that people who are more willing to share knowledge receive more knowledge than they donate. The eagerness of people was found to have a positive relation with receiving and donating knowledge.

With regard to networking, Wolff and Kim (2012) investigated the relations between personality (Big Five Factor Model) and networking behavior (within and outside of an organization). Results show significant effects of extraversion, openness and agreeableness on network behavior (building contacts, maintaining contacts and using contacts). Wolff and Kim (2012) suggested that extraversion could lead to 'incidental networking' (building contacts) and agreeableness could lead to more internal networking than external networking (maintain and use contacts). Openness was found to be more related to maintaining contacts than related to using contacts.

Besides the five factors of the Big Five Taxonomy, studies showed other personality factors that could influence networking and knowledge sharing behavior. Personal characteristics such as flexibility, tolerance for uncertainty, confidence and independence could influence innovative behavior and therefore probably also knowledge sharing behavior (Meijs et al., 2010). In addition, motivation, values, attitude, moods and emotions of people could affect knowledge sharing behavior (Van den Brink, 2003). Lin (2007) suggested that confidence and the pleasure in sharing knowledge are motivators for employees to share knowledge with others.

Demographic factors

Some studies analyzed the relationship between demographic factors and networking and knowledge sharing behavior. For example, Ismail and Yusof (2009) analyzed the relationship between demographic personal factors (i.e., gender, age, education level, and position grade) and knowledge sharing quality. Knowledge sharing quality was described as 'the extent to which one exchange knowledge (tacit or explicit) and together create new knowledge' (Ismail and Yusof, 2009). No relationship was found between the demographic factors and knowledge sharing quality. In addition, Pangil and Nadurdin (2008) studied the influence of demographic factors on knowledge sharing behavior. No significant relation was found between age, work experience, organizational tenure, job tenure and knowledge sharing behavior.

Although, research found no evidence of the influence of several demographic factors on knowledge sharing behavior, evidence of the influences of gender differences is mixed. For example, Klyver and Grant (2010) found that the entrepreneurial network (personally knowing other entrepreneurs) is smaller for female entrepreneurs than for male entrepreneurs. Similar results were found by the study by Pangil and Nadurdin (2008), which showed a slight difference between men and women with regard to tacit knowledge sharing behavior. It was suggested that men probably discuss more often their work during an interaction than women. On the other hand, Alhammad et al. (2009) found no significant relation between gender and knowledge sharing.

With regard to networking, Meijs et al. (2010) found that people with the same characteristics (e.g., experience, age or gender) are more likely to interact with each other than people with different backgrounds. Thus, it can be suggested that homogeneity stimulates interaction between individuals. However, increasing demographic diversity in a team could have a positive effect on team performance (Reagans et al., 2004). In addition, Zengyu et al. (2013) analyzed the influence of demographic factors on the usage of advice-seeking networks. Findings of this study suggest that people who are higher educated are more likely to use a professional network for advice, women are more likely to use personal networks than men and early stage entrepreneurs are more likely to use advice-seeking networks than later stage entrepreneurs.

Organizational size

Previous research showed that organizational size is important for explaining knowledge sharing behavior (e.g. Thorpe et al., 2005; Er-Ming et al., 2006; Chevez and Aznavoorian, 2014). The following sections describe in more detail relevant studies on organizational size. Table 3 shows an overview of these relevant studies. As can be seen no studies combine knowledge sharing at inter- and intra-organizational level when looking at organizational size.

Table 3. An overview of studies that focus on the effect of organizational size (KS= Knowledge sharing, N=Networking)

	Organizational level		Behavior	
	Inter	Intra	KS	N
Organizational size (Van Wijk et al., 2008)			X	
Organizational size (Er-Ming et al., 2006)		X	X	X
Organizational size (Chevez and Aznavoorian, 2014)		X	X	
Organizational size (Huggins and Johnston, 2010)	X		X	X
Organizational size (Thorpe et al., 2005)	X		X	X
Organizational size (Lechner et al., 2006)	X		X	X

Several researchers analyzed the relationship between organizational size and knowledge sharing behavior within an organization. For example, Van Wijk et al. (2008) found a positive effect of organizational size on knowledge sharing by summarizing existing quantitative empirical findings. This finding suggests that larger firms have a larger number and more diverse resources to share knowledge. Findings of the study by Er-Ming et al. (2006) showed that organizational size positively influences knowledge sharing behavior. Chevez and Aznavoorian (2014) found that larger organizations rely more on technology to share knowledge. On the other hand, individuals in smaller companies are more willing to share knowledge (Chevez and Aznavoorian, 2014).

Inter-organizational networks are mostly formed with supply-chain actors, such as customers, suppliers, collaborators and partners. Smaller organizations rely more on their business and social network outside of the organization, as a source of knowledge (e.g., Huggins and Johnston, 2010; Thorpe et al., 2005; Lechner et al., 2006). Also, smaller organizations networks are often more localized than networks of larger organizations (Huggins and Johnston, 2010). Thus, the size of an organization plays an important role in explaining knowledge network patterns. When firms grow, the tendency to participate in formal knowledge-based

collaborations outside of the region (e.g., collaborations with universities, private sector organizations) grows (Huggins and Johnston, 2010).

2.2.6 Conclusion

The aim of this section was to explore networking and knowledge sharing behavior, how networking and knowledge sharing behavior takes place and how this behavior is influenced by several contextual factors (i.e., individual and organizational factors).

Knowledge can be described as 'information possessed in the mind of individuals' and can be shared in different forms or types. The most common is the distinction between tacit knowledge (e.g., data, scientific formulas, manuals or patents) and explicit knowledge (e.g., procedures, competences, values and skills). A further distinction can be made based on the ownership of knowledge, namely between public codified knowledge, public non-codified knowledge, private codified knowledge and private non-codified knowledge. Knowledge of organizations can also be shared within an organization (intra-organizational) or between organizations (inter-organizational). This thesis aims to analyze knowledge sharing behavior between tenants/users of business centers, both at within and between organizations.

The literature review shows the importance of individuals in the knowledge sharing process, which is a process in which individuals mutually exchange knowledge and is influenced by actors, content and context. Knowledge sharing behavior is dependent on the individual and organizational context. It is also recognized that network ties, both informal and formal ties, are important for explaining knowledge sharing behavior. A larger network could lead to more information and resources from other individuals and vice versa. Also, the structure (business network or social network) plays an important role in knowledge sharing behavior. Furthermore, weak ties could provide access to useful new information and strong ties could hinder new information because there are more similarities between strong ties. This tie strength can be measured based on the frequency of interactions, the duration of relationship and the closeness of the relationship between actors.

With regard to individual factors, studies show relations between personality (e.g., agreeableness, conscientiousness, openness and neuroticism), demographic factors (e.g., gender, age, income and education level) and knowledge sharing or

networking behavior. Organizational size was found to influence knowledge sharing and/or networking behavior.

A review of the relevant literature shows that many relations have been reported between knowledge sharing, networking behavior and contextual factors. However, these relations are very complex. In addition, these relations have not been considered simultaneously in a single model. Therefore, further research is required to understand the relations between individual- and organizational factors, networking and knowledge sharing behavior.

2.3 Physical work environment

This section provides an overview of existing literature on the relationship between the physical work environment, networking and knowledge sharing behavior. It has been recognized that the physical work environment could influence the performance of organizations, help to increase creativity, improve work outcomes, reduce stress or influence the physical well-being of individuals (Kastelein, 2014). Interactions at work could stimulate sharing interests or knowledge and could stimulate competitiveness among workers (Suckley and Dobson, 2014). Although the awareness of the importance of the work environment increases and organizations increasingly strive for work environments that stimulate interaction and collaboration (Allen et al., 2004), creating an effective workplace design that stimulates knowledge sharing among employees, remains a major challenge for organizations (Kastelein, 2014). Still little is known about the effect of the physical environment on networking and knowledge sharing behavior. In particular, research on networking and knowledge sharing behavior between tenants/users of business centers is limited. To analyze this relationship, insight into the existing literature on the effect of aspects of the physical work environment on networking and knowledge sharing behavior is needed.

First, an introduction of the physical work environment is described, followed by a section on relevant literature on the influence of physical work environment factors on networking and knowledge sharing behavior. Finally, this section ends with a conclusion.

2.3.1 Introduction

It is recognized that the physical work environment influences networking and knowledge sharing behavior within organizations (e.g., Van Sprang et al., 2013;

Kastelein, 2014; Appel-Meulenbroek, 2014; Rashid et al., 2009). However, the physical work environment does not ensure that networking and knowledge sharing behavior actually will take place (e.g., Kastelein, 2014; Stryker et al., 2012). Knowledge sharing behavior and networking of users is also influenced by multiple other factors such as the individual and organizational, as described in the previous section on networking and knowledge sharing. The physical work environment can be distinguished at three levels: place, space and use (see Table 4) (Van Meel, 2000; Van der Voordt and Van Meel, 2000; Kastelein, 2014).

Table 4. Place, space and use (Van Meel, 2000)

Place	
Central office	A building where the workplaces of employees from the same unit or department are located
Telework office	A workplace that is physically disconnected from the central office (e.g., satellite office, business center, guest office, home office and instant office)
Space	
Cellular Office	An enclosed space with floor to ceiling walls designed to accommodate 1-3 persons
Group Office	An enclosed space with floor to ceiling walls designed to accommodate 4-12 persons
Open-Plan Office	An open space not divided by panels designed to accommodate 13 or more persons
Half Open-Plan office	Cellular offices situated around an open space, which is designed to accommodate common facilities and group work.
Combi-office	Cellular offices situated around an open space, which is designed to accommodate common facilities and group work.
Use	
Personal Office	An owned workplace used exclusively by a single employee
Shared Office	An owned workplace used by employees on a rotating basis
Non-Territorial Office	A workplace used by employees who do not own a workplace

With regard to the place level, people can work at the central office or at a workplace at a remote location of the central office (e.g., home office, business center, virtual office). The place where people work has changed over the past decades through developments in information and communication technology (ICT) (Heerwagen et al., 2010). Through the easy access to information and communication through electronic tools, people are more able to work at a remote location, such as at a home office, 'hot-spots' in public venues (e.g., café, restaurant

or hotel) or when travelling between two locations (e.g., planes, trains and boats) (Cole et al., 2014). Blakstad (2013) divided the places where people can work into three types of places: the office (e.g., central office or regional office) (1st place), from home (2nd place) and from anywhere (e.g., airport, café, hotel, social meeting place, coworking place) (3rd place). This study focuses on networking and knowledge sharing in business centers as a 1st or 3rd place (e.g., a central office, social meeting place, a telework office or a coworking office), excluding the 2nd place (i.e., working from home).

The office concept has changed over the past decades (Gottschalk, 1994) and new office designs have emerged. In a more recent study, Danielsson and Bodin (2009) defined seven types of offices based on their architectural and functional features. The first type is the cell-office (1 pers. /room), where a corridor connects rooms for a single person and most equipment is located in the rooms. Next, the shared room office (2-3 pers. /room) is characterized by rooms for 2-3 persons and is often a result of team-based work or a lack of space. The open-plan office is an office where people work in a common workspace. There are small open-plan offices (4-9 pers. /room), medium open-plan offices (10-24 pers./ room) and large open-plan offices (>24 pers. /room). Finally, Danielsson and Bodin (2009) described office types with a more flexible layout, namely the flex office and the combi-office. First, the flex-office often can be defined as an open-plan layout with flexible shared workstations and a good information technology (IT) system. Next, the combi-office includes several additional spaces such as spaces for teamwork, meetings, etc. (Danielsson and Bodin, 2009) and is also called as 'the CoCon-office (COmmunication and CONcentration)' (Appel-Meulenbroek et al., 2011).

Bjerrum and Bødker (2003) suggested that the newest office concept emerged in the 1990's through new ways of using space through developments such as telecommunication, information technology and changes in work behavior. It includes different spaces for different activities (Bjerrum and Bødker, 2003). This new activity based office design is also called 'the multi-space office' (Boutellier et al., 2008). Users of these activity-based offices have no dedicated office space; so users are allowed to work at all available workplaces and shared spaces/facilities (Kleijn et al., 2012). It includes shared open spaces for interaction and communication between individuals, shared offices for (confidential) work that needs more concentration and privacy, project rooms for teamwork, café areas for more informal meetings/interactions and external and internal meeting rooms for more formal meetings/interactions (Bjerrum and Bødker, 2003). Van Sprang et al. (2013)

suggested that an activity-based workplace concept, that provides the freedom of choosing between different work spaces, is important for increasing the productivity of individuals. However, many offices that offer older types of office concepts still remain.

Besides the different types of office space and use, there is a wide variety of workspace preferences (Allen et al., 2004). Different personal preferences require different types of workspaces (Martens, 2011). Allen et al. (2004) described several different workspaces that could meet all the different workspace preferences, namely an owned desk (fixed workstation), hot desk (shared desk), touchdown workbenches (workstations that supports short-stay, drop-in style working), quiet booth/study, booth/carrel (semi-open or enclosed hot desk that supports concentration), team table (an adaptable table to support team working), formal meeting rooms, informal meeting area/social space/breakout space, quiet area/zone/room, project or creative space and a hub space (area for photocopying, printing, post etc.). All office types could accommodate (part of) these spaces.

Kabo et al. (2015) used individual's 'functional zone' to measure the zone overlap of individuals in the physical work environment. The functional zone consists of several nodes: workspaces (offices), nearest public space (restrooms), closest circulation space (elevators and stairways) and connector spaces (hallways). Furthermore, Kastelein (2014) also added shared spaces (e.g., meeting rooms, informal areas and quiet rooms) and facilities (e.g., coffee point, facility point, and cafeteria) to characterize the physical work environment. These shared spaces or facilities are important, especially in business centers, because these spaces or facilities could facilitate networking and knowledge sharing behavior between individuals of different organizations.

2.3.2 Physical work environment, networking and knowledge sharing

This section describes relevant literature on the effect of physical work environment on networking and knowledge sharing behavior, based on the three levels of the physical work environment (place, space and use). The first level refers to the different business center concepts (regular business centers, serviced offices, incubators and coworking offices), which are discussed in Chapter 2. This can be the central office of an organization or offices that are physically disconnected from the central office. Also, the place level refers to the location, where the business center is situated. The space level refers to the type of office space. Next, the use level

refs to the workplace level (functional zone of individuals) and how the work environment is used by tenants/users. The following sections describe relevant literature on the place level, space level, use of space level and on shared spaces/facilities. Thus, many different office concepts, preferences and types of workspaces can be distinguished. Different office designs and workspaces probably could influence networking and knowledge sharing behavior in a different way, as shown by several studies (e.g., Kastelein, 2014; Suckley and Dobson, 2014; Rashid et al., 2009). Although previous studies mostly focus on the physical work environment of single tenant offices, these studies could provide more insight into the relation between the physical work environment of business centers and networking and knowledge sharing behavior.

These studies mainly focused on the influence of the physical work environment on interactions or on collaboration. Appel-Meulenbroek (2014) suggested that knowledge is shared through interactions (meetings and documented information exchange) and through collaboration (informally work together, share ideas, information or resources, share the same vision for the firm, have a mutual understanding and work together as a team). In addition, Oseland (2012) suggested that 'collaboration involves two or more individuals working towards a common goal and creating a new product (e.g., an idea, solution, or insight) beyond what they could have achieved individually'. Furthermore, Heerwagen et al. (2004) suggested that collaborative knowledge work consists of three dimensions: awareness (knowing what is happening in the surrounding space and the meaning of events and actions), brief interaction (functional communications and social interactions) and collaboration (two or more people working together). Some other studies did not make a distinction between interactions and collaboration. In this thesis, interactions, including collaboration, will be analyzed.

Place

It is recognized that the location could influence networking and knowledge sharing behavior (e.g., Simmie, 2010; Bathelt et al., 2004). Networking and knowledge sharing is highly dependent on the location of organizations. For example, a metropolitan location encourages face-to-face contact with other parties such as enterprises, institutions, service providers and governments. In addition, innovative activities are highly concentrated in urban regions (Simmie, 2010). Simmie suggested that regional characteristics are important factors for the supply of knowledge, namely social networks could benefit from the proximity of actors, labor mobility

could contribute to knowledge sharing (which is easier within a metropolitan labor market) and the agglomeration of knowledge resources could increase the 'pick and mix' of knowledge input, which is required for the innovation process.

Green (2014) argues that start-up enterprises tend to locate in high-density urban areas for the positive effects of knowledge sharing and clustering. Dense locations (e.g., city centers) encourage knowledge spillovers (exchange of ideas among individuals) (Carlino, 2001). The high density in cities creates a dynamic milieu with many sources of knowledge (Aslesen and Jakobsen, 2007).

Most studies analyzing geographical factors such as density focused mostly on the influence of density on regional innovation and growth. For example, Knudsen et al. (2007) analyzed the influence of the density of creative workers on innovation in a metropolitan area. Results show that the density of creative workers (concentration of people with expertise, skills and knowledge) stimulates innovation. The density of organizations in a specific field refers to clusters.

Organizations located in a cluster could provide opportunities for creating and transferring complex forms of knowledge (Easterby-Smith et al., 2008). Therefore, probably, the main factor for companies to settle in such locations is to develop and exchange knowledge (Van der Borgh et al., 2012). Porter (1998, p.78) defined clusters as: 'geographic concentrations of interconnected companies and institutions in a particular field'. In addition, Yoong and Moline (2003) described business clusters as 'local concentrations of competitive firms in related industries that do business with each other'. Bathelt et al. (2004) suggested that a cluster has two dimensions namely:

- Horizontal dimension: organizations in the similar field that produce similar products and are competitive with each other. Organizations benefit through co-location, proximity and co-presence.

- Vertical dimension: organizations which are complementary and which are linked through a network of suppliers' services and customer relations.

These geographic concentrations or 'hot-spots' (Porter, 2000) are aimed at stimulating interactions within and between companies, institutions and governments (Atzema et al., 2011; Van der Borgh et al., 2012) and benefit from co-location (Forsman and Solitander, 2003). Regional clusters are characterized by the diversity of actors (e.g., suppliers, consumers, peripheral industries, governments and universities) and the concentration of collaborative networks, which could facilitate opportunities for economic development (Kajikawa et al., 2010).

Organizations that are located in a cluster could benefit from shared knowledge within a cluster to produce new knowledge and innovations (Bathelt et al., 2004). A cluster with similar organizations could lead to more competition, which stimulates organizations to become more innovative (Van den Klundert and Van Winden, 2009). However, Morosine (2004) suggested that geographic proximity could also have some disadvantages such as a higher competition level, the disappearance of specialized labor, the imitation of technology and product innovations and shared market intelligence among organizations. Connell et al. (2014) analyzed industry clusters and how they support knowledge sharing behavior. They suggested that not only the location in a cluster supports knowledge sharing behavior; cluster firms have to meet each other in the field and mix with each other. Therefore, it is important that managers of clusters focus their strategies on knowledge sharing.

At a smaller scale, business parks could provide organizations more opportunities for interaction and knowledge sharing. There are several types of specific business parks such as science parks, technology parks or university campuses. Some of these business parks are focused on a specific sector or branch (e.g., life sciences, creative industries or health) and other business parks focus on a wide variety of businesses. These parks have several advantages. For example, it can bring several organizations together (e.g., university researchers and the industry) and facilities/services can be shared (e.g., sharing expensive facilities such as laboratories, clean rooms and libraries) (Van den Klundert and Van Winden, 2009). Organizations that are located at a science park are more likely to have connections with local universities and with each other (Chan and Lau, 2005). Chan et al. (2010) studied knowledge sharing behavior of organizations located at science parks, using an online questionnaire. The questionnaire included questions on knowledge sharing behavior with other organizations located at the science park and with organizations from outside of the science park. Two groups were distinguished, namely organizations who share knowledge with other on-park organizations and organizations that do not. Results showed that organizations who share knowledge with other on-park organizations have more (informal) direct ties, get more useful knowledge and receive more unintended knowledge from other organizations (Chan et al., 2010).

Although the location has an important relation with knowledge sharing behavior, the location (i.e., place) will not be taken into account in this thesis. This thesis focuses on the influence of physical work environment in business centers.

Space

Different types of office concepts could facilitate networking and knowledge sharing in a different way. For example, Boutellier et al. (2008) found an increased number of short interactions and weak ties in a multi-space office (i.e., it offers a high diversity of workplaces depending on the activity), compared to a traditional cellular office. It is recognized that open-plan offices stimulate the number of interactions and therefore probably knowledge sharing behavior (e.g., Blakstad et al., 2009; Becker and Sims, 2001; Chigot, 2003). For example, Becker and Sims (2001) found that a more open work environment supports face-to-face interaction between workers. However, the duration of interactions (of managers and their teams) was found to be shorter in more open work environments. Blakstad et al. (2009) studied the influence of the relocation from a cellular office to an open-plan office. Results of the study by Blakstad et al. (2009) suggested that open plan offices stimulate informal contacts between coworkers, collaboration and knowledge sharing behavior. Another study by Arge (2006), analyzed the relocation of Telenor's (a large telecom company) to a more open and flexible workspace. Most respondents reported that the new open work environment enhances communication and collaboration within a business unit. Also, a large number of respondents reported that the new work environment enhances knowledge sharing. Furthermore, Rashid et al. (2009) analyzed the effect of different types of open-plan offices on interaction. Results of their study showed that open-plan offices with a higher visibility and accessibility facilitate more face-to-face interactions.

On the other hand, open-place offices could result in more noise, reduced privacy and difficulties performing work that needs concentration (Kim and De Dear 2013; Van der Voordt and Van Meel, 2000; Blakstad et al., 2009; Arge, 2006). Also, some other studies found opposite results with regard to the number of interactions or collaboration. For example, Suckley and Dobson (2014) investigated the impact of the relocation from a traditional cellular office to an open-plan office on the spatial and social relations of a university research department. The relocation decreased the number of interactions. The decrease of interactions could be explained by the higher visual connectivity of the open-plan office that could lead to more efficiency in the interaction of workers. Also, the fear for disturbing others could lead to a decreased number of interactions (Suckley and Dobson, 2014). A comparable study was conducted by Lansdale et al. (2011). They analyzed the influence of changing the spatial layout from a cellular office to an open plan office on interactions and collaboration among researchers at a university department. Findings show that the

change of spatial layout decreased the number of face-to-face interactions and collaboration. Furthermore, Hua et al. (2010) found a correlation between the perceived support from the work environment for collaboration or interaction and a lower level of floor plan openness.

Use of space

Studies found that interactions often occur in or near workstations (e.g., Rashid et al., 2008). This states the importance of workspaces for networking and knowledge sharing behavior. For example, a non-territorial office space (a workspace used by employees who do not own a workspace) could lead to problems for interactions; people cannot find each other or a workspace (Van der Voordt and Van Meel, 2000). The condition for non-territorial offices is that the density of offices has to be moderate. A high density leads to difficulties in moving around and a low density leads to clusters of people (Inamizu, 2007).

Binyaseen (2010) found that employees' participation (the mechanism of work dialog among workers) is encouraged by workspaces with a minimum of partitions. Lower partitions allow greater visibility and accessibility (Chusid, 2001). In addition, Stryker et al. (2012) found, comparing low-visibility and high visibility environments, that the type of workspace (open, low-walled workspaces) stimulates face-to-face interaction in low-visibility work environments and is mediated by collaboration opportunities (e.g., the total number spaces where face-to-face interaction can occur within a 25 meter radius of the workspace).

Physical proximity between users of a work environment could also influence networking and knowledge sharing behavior. People who are in close proximity (and can see each other), are probably more likely to connect and interact with each other (Appel-Meulenbroek, 2010). Several studies analyzed the relation between proximity and knowledge sharing or interaction. For example, findings of an early study by Allen (1971) showed that the chance for spontaneous interaction between employees reduces to zero when the distance between employees is more than 30 meters. In addition, Kastelein (2014) found a significant correlation between proximity (workspaces in close proximity) and knowledge sharing interactions of employees. Steen (2009) found a higher number of interactions between office workers (who are sitting close by and can see each other). Moreover, Wolfeld (2010) found that proximity of employees and the frequency of passing others workspaces positively influence the number of unplanned interactions.

Furthermore, Wineman et al. (2009) analyzed the role of spatial layout in the formation and maintenance of social relations (whether they co-authored one or more papers together). Academic publications in her thesis referred to innovation and co-authorship referred to successful collaboration. Results showed that being in the same department and at a shorter distance increases the likelihood of co-authorship, which is linked to innovation (Wineman et al., 2009). Furthermore, Criscuolo et al. (2010) studied the importance of four different dimensions of proximity for knowledge sharing in professional services firms. These dimensions were cognitive (similar skills), geographical (the distance between desks), social (the number of shared friends of the individuals in the dyad) and organizational proximity (the number of projects two individuals in a dyad have worked on together). These variables were measured on the dyad level. Results suggested that colleagues working in the same division of an organization are more likely to share knowledge. A higher geographical proximity was found to stimulate knowledge sharing too, even when the skills of individuals within the dyad do not overlap (Criscuolo et al., 2010).

Some studies tried to examine the effect of more detailed layout factors of the openness of an work environment, namely accessibility and visibility (Rashid et al., 2006), on networking and knowledge sharing behavior. For example, Chaboki and Ansari (2013) analyzed the relations between these layout factors and organizational performance, mediated by face-to-face informal interactions. Findings show significant correlations between the accessibility (the degree of permissiveness of every employee to reach others, the distance of movement and the level of comfort in this process), visibility (openness and clarity of the employee's location to observe other employees or facilities) and informal interactions. Rachid et al. (2006) also studied the effect of spatial layouts (visibility, accessibility and openness), through spatial behavior (visible co-presence and movement), on the number of face-to-face interactions. Visible co-presence was defined as 'the number of people who can be seen from a given point'. In addition, movement was defined as 'the number of people moving along a path of observation'. Results of this study showed an effect of visible co-presence on the number of interactions, regardless of the movement in offices.

Toker and Gray (2008) analyzed whether the spatial layout of research offices and labs influence face-to-face technical consultations in university research centers. Three aspects were found to affect the frequency of face-to-face consultations, namely the accessibility (the numbers of spaces to be passed through in order to reach from one space to another in a system), visibility (the area that can be seen

from each particular space) and walking distances. Furthermore, Appel-Meulenbroek (2014) analyzed whether accessibility through visibility and accessibility through placement within the room could stimulate knowledge sharing behavior. Results of this study showed that the accessibility through visibility (same room, visible workspaces and compactness) has the strongest relation with the number of knowledge sharing meetings. Penn et al. (1999) studied, using space syntax techniques, interactions in the work environment. This study showed that employees are more likely to interact with each other in high accessible spaces. In addition, the lack of visibility was found to decrease unplanned informal interactions.

Furthermore, Kabo et al. (2015) analyzed the influence of zone overlap on collaboration in biomedical research buildings. They suggested that 'zone overlap better captures the real effects of space on collaboration dynamics than do physical distance measures that index costs of planned interactions'. Zone overlap was measured by areal overlap (the sum of the area of the nodes in the intersection (overlap of two functional zones) set) and path overlap (the sum of the total length of node-to-node links). A relation was found between path overlap and collaboration.

Table 5 shows an overview of the characteristics of the workspace, discussed above, that could influence networking and/or knowledge sharing behavior. Although previous studies showed that the workspace and their specific characteristics (i.e. density, proximity, accessibility, visibility and walking distances) are important for increasing face-to-face interactions among employees, this thesis focusses only on the type and use of workspaces. As business centers facilitate office space for multiple organizations, it is more relevant to look at the workplace than looking in more detail at workspace characteristics.

Table 5. Studies on the influence of characteristics of the workspace (individual's functional zone)

	Characteristics	Relations
Van der Voordt and Van Meel (2000)	Use of workspaces	- A flexible workspace could lead to problems for interactions
Inamizu (2007)	Density of workspaces	- High density leads to difficulties in moving around and a low density leads to clusters of people
Binyaseen (2010)	Partitions (number of)	- A minimum of partitions leads to more interactions between workers
Chusid (2001) and Stryker et al. (2012)	Partitions (height)	- Lower partitions allows greater accessibility and visibility and this leads to more interactions
Steen (2009), Wolfeld (2010), Allen (1971), Kastelein (2014), Wineman et al. (2009), Criscuolo et al. (2010)	Proximity (physical)	- People working in close proximity are more likely to interact with each other - Workspaces in close proximity stimulate knowledge sharing
Chaboki and Ansari (2013), Penn et al. (1999), Toker and Gray (2008), Appel-Meulenbroek (2014)	Accessibility	- Accessibility influences the number of (informal) interactions - Accessibility through visibility (same room, visible workspaces and compactness) has an association with the number of knowledge sharing meetings
Penn et al. (1997), Chaboki and Ansari (2013), Toker and Gray (2008)	Visibility	- Visibility influences the number of informal interactions
Rachid et al. (2006)	Visible co-presence	- Visible co-presence (the number of people who can been seen from a given point) influences the number of interactions regardless of the movement in offices
Toker and Gray (2008), Appel-Meulenbroek (2010)	Walking distances	- Walking distances influences the number of face-to-face interactions - Chance for spontaneous interactions is higher within a distance between workers of less than 30 meters
Kabo et al. (2015)	Path overlap	- Path overlap increases collaboration

Shared facilities/spaces

It is recognized that shared facilities and space could stimulate interactions and knowledge sharing behavior. For example, Staplehurst and Ragsdell (2010) analyzed facilities (meeting rooms, desk, deliberate knowledge sharing facility, canteen, drinks machine, corridor/reception, stairs and car park) used for knowledge sharing activities in SMEs and compared two case studies in the UK. Respondents in both companies ranked, besides desks, meeting rooms as the most important knowledge sharing facility. Results of the study by Kastelein (2014) showed that open and common workspaces, common shared areas (e.g., kitchen, play/game rooms, lounges or a library), sufficient and available meeting facilities are the most important facilities for easy interaction.

Hua et al. (2010) studied preferred spaces for collaboration and interaction. Findings showed that for casual conversations, individual workstations, kitchen or coffee areas and meeting rooms were used the most. With regard to collaborative work, most respondents used closed meeting rooms, individual workstations and open meeting areas. Shared print/copy areas, kitchen or coffee areas and circulation areas were used less frequently for collaborative work. Furthermore, results of the study by Hua et al. (2010) showed a correlation between the perceived support of the work environment for collaboration and interaction and layout-scale spatial variables (a short distance between the workstation and a meeting space and a high percentage of the layout dedicated to meeting, service and amenity spaces). The proximity between workers' workstations and meeting spaces could influence the way people use a meeting space. People working in close proximity of the meeting spaces use these spaces more often (Brager et al., 2000). Also, Toker and Gray (2008) showed that meeting spaces should be well integrated and visible for users to increase the number of interactions.

Informal spaces allows people to relax and connect with other individuals which could lead to more trust among individuals, that eventually leads to more willingness to share knowledge (Chevez and Aznavoorian, 2014). However, informal meeting spaces have to be more accessible and attractive to stimulate informal meetings/interactions (Van Sprang et al., 2013). Furthermore, Wineman et al. (2014) suggested that an office space that is located in close proximity of a social space (e.g., canteen) stimulates the formation of social relations and supports innovation. Moreover, Binyaseen (2010) suggested that employees' participation (the mechanism

of work dialog among workers) is encouraged by using furnishing to create flexible individual workspaces and by shared facilities.

Table 6 shows an overview of the shared facilities/spaces which are discussed above, that could influence networking and/or knowledge sharing behavior. These facilities/spaces are an important aspect for analyzing the influence of the physical work environment on networking and knowledge sharing behavior.

Table 6. Studies on the influence of shared facilities/spaces on networking and knowledge sharing

	Characteristics	Relations
Staplehurst and Ragsdell (2010), Kastelein (2014), Binyaseen (2010)	Facilities	- Desks and meeting rooms are the most important knowledge sharing facilities - Open and common workspaces, common shared areas (e.g., kitchen, play/game rooms, lounges, library), sufficient and available meeting facilities are the most important facilities for easy interaction
Hua et al. (2010)	Preferred spaces for casual conversations and collaborative work	- Casual conversations: individual workstations, kitchen or coffee areas and meeting rooms - Collaborative work: closed meeting rooms, individual workstations and open meeting areas
Chevez and Aznavoorian (2014), Van Sprang et al. (2013), Wineman et al. (2014)	Informal spaces	- Informal spaces could increase the trust among people and therefore probably the willingness to share knowledge. - Accessible and attractive informal meeting spaces stimulate interactions - People who work in close proximity of a social space, stimulates the formation of social relations.

2.3.3 Conclusion

In this section, several factors at the place, space and use level are discussed. It is recognized that the location, the type of office concept and the use of workspaces could influence networking behavior and (eventually) knowledge sharing. Research on the location shows that density level of the area, the location in a cluster and the location at a business park (type of location) could influence networking and knowledge sharing behavior. Clusters could provide access to shared knowledge for organizations. A higher density (urban area) has a positive influence on networking and knowledge sharing, because of the higher geographic proximity and the highly concentrated innovative activities in the area. Also, the location at a business park (e.g., science parks, technology parks or university campuses) could influence networking and knowledge sharing behavior. This refers to where the business center is located (type of location). However, this study focusses on the physical work environment at the scale of a business center. Therefore, the location is not taken into account in the analyses. Performing more in-depth research on the location of business centers and the influence of this location on peoples networking and knowledge sharing behavior is left for future research.

There are several types of office concepts that could influence networking and knowledge sharing behavior in a different way. Studies focusing on the effect of different office concepts on networking and knowledge sharing behavior are still limited. Many studies focused on the relocation from a cellular office to a new more open-plan office. Although most studies showed that a more open environment leads to more interactions, some other studies show opposite results.

Furthermore, the use level refers to the workspace level and characteristics of this individual zone. It appears from the literature review that the use of workspaces (fixed or flexible workspace), could have an effect on networking and knowledge sharing behavior. In addition, previous studies also found relations with workspace density, the height and number of partitions, accessibility, visibility, visible co-presence, walking distance, physical proximity and path overlap. However, these detailed workspace characteristics will not be taken into account in this study as these are more relevant in single-tenant offices where employees share office space and sitting close to each other. At business centers, organizations not always share office space or even work at the same floor.

Shared facilities or spaces were found to play an important role in facilitating networking and knowledge sharing behavior. The type of facility or space (especially informal spaces) was found to increase the number of interactions among individuals. This could eventually lead to more knowledge sharing.

Although several relations came forward in the literature review, studies that focus on the physical work environment of business centers are still limited. In addition, previous studies on the physical work environment did not take into account several contextual factors. Most studies focused particularly on the physical work environment or on context factors that could influence networking and knowledge sharing behavior. To get insight in the relationships between the physical work environment and networking and knowledge sharing behavior, all relevant variables have to be included. In addition, previous studies focused on single-tenant buildings and on knowledge sharing behavior within a larger organization. Studies on the influence of the physical work environment of business centers on networking and knowledge sharing behavior between individuals of different organizations were still limited. This study addresses these gaps in previous research on the influence of the physical environment on networking and knowledge sharing behavior.

2.4 Conclusion

An examination of the relevant literature showed relationships between the physical work environment, networking and knowledge sharing. However, existing studies mainly focus on larger organizations in single-tenant offices. Research on networking and knowledge sharing within and between organizations at the scale of a business center is still scarce. Therefore, especially in business centers, where interactions are mostly stimulated by shared services, facilities and spaces, further research on this topic is needed. Based on results of previous studies, it is assumed that physical- and non-physical characteristics of business centers influence knowledge sharing, mediated by the influence of networking behavior.

3

Differences between business center concepts in the Netherlands[1]

3.1 Introduction

Previous studies tried to categorize business center concepts into four types of business center concepts, namely business centers, serviced offices, coworking offices and incubators. However, it is still not clear if these types of business center concepts exist in the market and indeed significantly differ from each other. This chapter aims at analyzing business center concepts and their differences based on specific characteristics (i.e., spaces, facilities/services, objectives and tenants).

3.2 Data collection and sample

It appeared from the literature review that several variables (objective, tenants, spaces, atmosphere and facilities/ services) are important for identifying the business center concepts. Also, it is recognized that business centers could vary depending on the business model, type of property and capacity of the business center (e.g., Lesáková, 2012; European Commission, 2002; Gibson and Lizieri, 1999). Therefore, data on all these variables was collected, using an online questionnaire among owners/managers of business centers in the Netherlands. To get more insight in the business center sector, more detailed information was collected than described by the existing literature.

Regarding the objectives of the business centers, respondents were invited to choose one or more of the following objectives (Calder and Courtney, 1992; Chen et al., 2006; Gibson and Lizieri, 1999; Moriset, 2014; Aernoudt, 2004):

- To offer office space;
- To offer shared facilities and services;
- To offer office space with flexible terms (e.g., flexible rental period);
- To offer full-fitted office space;
- To offer managed technology (e.g., telecommunication, web conferencing, broadband technology or a virtual assistant);
- Creating a work community (stimulating cooperation and synergy among tenants);
- To support and facilitate start-up enterprises;
- Stimulate local employment;
- Stimulate knowledge transfer;
- Stimulate economic development and growth in the region;
- Other objectives.

In addition, respondents were asked about the business model of the business center (for-profit or non-profit). Information on tenants was collected by asking respondents on which target group(s) the business center focuses, the current number of tenants of the business center, and which lease contracts are offered. They could select one or more target groups namely self-employed people, independent workers (work at an organization that is based at another location), SMEs, start-up enterprises, large enterprises and others (Parrino, 2013; Sykes, 2014; Laterveer, 2011; Aernoudt, 2004). The atmosphere between tenants/users in the business center was measured by asking respondents if there is a formal atmosphere or a more informal atmosphere between tenants/users.

To collect information on facilities/services offered by the business centers, respondents were asked to select which services are offered by the business center. They could select one or more of the following facilities/ services, described by the existing literature (e.g., Laterveer, 2011; Calder and Courtney, 1992; Van den Berg and Stijnenbosch, 2009; Ketting, 2014; Troukens, 2001): business services, secretarial services, cleaning and maintenance, security, managed technology, services, consultancy services, networking events, catering, use of coffee and tea makers, furniture and other facility/ service. If these facilities/ services are offered, respondents had to indicate if these services are included in the rental price. In addition, respondents were asked whether facilities/services are offered by the 'pay what you use' principle.

Respondents were also questioned about the different types of spaces offered by the business center. These spaces are based on the workspaces described by Allen et al. (2004) and some common known other office spaces, namely a concentration room, office space with fixed workstations, with shared workstations, with a combination of fixed and shared workstations, atelier space, laboratory space, conference room, informal/social space, project/creative space, reception/entrance, kitchen, coffee corner, storage room, showroom, business unit or other spaces. In addition, respondents were asked to indicate whether these spaces were shared by tenants/users.

Regarding the capacity of the business centers, information was collected on the GFA in m^2, the minimum rentable surface in m^2 and the vacancy in m^2. Moreover, respondents answered questions about the type of property (the number of years the business center exists and the construction year of the business center).

3.2.1 Data collection

The five largest municipalities in the Netherlands were asked to provide a list with (all) business centers that were located in the municipality, which provided 260 business centers. Also, a list of 204 business centers in the Atlas of Business Centers, established by Van den Berg and Stijnenbosch (2009) based on collected data on business centers in 2004 in the Netherlands, was used. In addition, 54 business centers were brought forward in interviews with 13 real estate professionals. Some of the business centers were mentioned double by the municipalities, the Atlas of Business Centers and the real estate professionals. Owners/managers of a total of 446 business centers were approached by an email. Those who did not fill in the questionnaire received a reminder and were subsequently called. From the 446 business centers, owners/managers of 139 (30%) returned a completed questionnaire.

3.2.2 Sample characteristics

Table 7 shows some of the sample characteristics. Respondents were asked to assess to which type of business center concept their business center belongs. The frequencies of the different types of business center concepts in the sample delivered a similar spread of serviced offices (32%) and incubators (12%) as the sample derived by Van den Berg and Stijnenbosch (2009). The sample (2015) included much less regular business centers (25%) and more coworking offices (14%), which might reflect the market changes discussed before. The sample derived by Van den Berg and Stijnenbosch (2009) did not include any coworking offices. Some respondents reported other business center concepts (17%), such as a combination of the four business center types, a business center based on vacancy management, a coworking office with residential-working combinations, ateliers, a combination of a conference and an event center with a collaborative work environment and a school building in combination with office space for external tenants. These findings suggest that the business center sector has changed since 2004 and the four business center concepts do not represent the whole business center sector.

Most respondents reported the objective 'to offer office space', 'to offer shared facilities and services' or 'to offer office space with flexible term'. Notably, more than half of the respondents reported that the objective of the business center is to create a work community to follow the trend in demand. Existing literature suggest that specifically coworking offices focus on creating a work community (e.g.,

Van Meel and Brinkø, 2014). However, only 14% of respondents reported the business centers as a coworking office. This suggests that there are more types of business center concepts that focus on creating a work community. A large number of business centers are focused on supporting and facilitating start-up enterprises. This is a high number compared to the low number of incubators (12%) in the sample, which according to the existing literature are the only type that is focused on stimulating start-up enterprises (e.g., Lesáková, 2012; Aernoudt, 2004). Furthermore, 75% of the business centers is profit oriented.

Most business centers offer a one year or a one month lease contract. All respondents reporting a one hour lease contract, also reported a one day lease contract, and most of these respondents reported a one month lease contract as well. Moreover, most of the respondents that reported a 2 year lease contract, also reported a one year lease contract. These findings suggest that most business centers in the sample offer flexible lease contracts. Now, opposed to the longer leases of offices in the past, leases have become shorter and more flexible (Halvitigala and Zhao, 2014).

Regarding services/facilities, many business centers offer cleaning and maintenance services, security, managed technology services, the use of coffee and tea maker and secretarial services. Consultancy services and business services are the least available in business centers. Almost half of the business centers in the sample offer networking events, catering, furniture and secretarial services. A few respondents (9%) reported other services/facilities such as fitness, the use of e-bikes or business and employee benefit services (dry cleaning, clothing repair, bookings and reservations). Furthermore, half of the business centers (55%) offer some or all of the services/facilities based on the 'pay what you use' principle.

Many business centers in the sample offer a conference room, reception/entrance, office space with fixed workstations, informal/social meeting space and a kitchen. A few business centers offer laboratory spaces; these are particularly incubators focusing on a particular business sector (e.g., Pivot Park, Catalyst, Meditech Center Groningen or Biopartnercenter Wageningen). Some of the respondents (15%) reported other types of spaces such as a restaurant, event area, café, dance and sports or fitness club/room, auditorium, theater, shared terrace, retail units, exhibition spaces and cleanrooms.

The oldest building in the sample was constructed in 1889 and the latest building was constructed in 2014. The maximum number of years a business center

exists in its current state is 45 years. The sample contains business centers constructed over all time periods. Most of the business centers in the sample are constructed after 1980; no buildings are constructed during the Second World War (between 1939 and 1945). On average they hold 39 tenants (with a maximum of 350). The minimum of the minimal rented surface in m^2 is 0. This is because some of the business centers only offer a single workplace and therefore they reported this workplace as 0 m^2. The maximum minimal rented surface is 5530 m^2 and the mean is 89 m^2.

Table 7. Sample characteristics business center concepts (N=139)

		Freq.	*%*
Objectives	To offer office space	114	82
	To offer office space with flexible terms	100	72
	To offer shared facilities and services	93	67
	Creating a working community	86	62
	Stimulate knowledge transfer	64	46
	To support and facilitate start-up enterprises	64	46
	To offer full-fitted office space	57	41
	To offer managed technology	52	37
	Stimulate regional economic growth	38	27
Target group	Start-up enterprises	110	79
	SME's	104	75
	Self-employed people	102	73
	Independent workers	54	39
	Large companies	42	30
Services/facilities	Cleaning and maintenance	120	86
	Security	96	69
	Managed technology services	91	66
	Use of coffee and tea maker	84	60
	Secretarial services	68	49
	Networking events	65	47
	Catering	64	46
	Furniture	63	45
	Workshops and lectures	51	37
	Business services	37	27
	Consultancy services	25	18

Table 7. Continued

					Freq.	%
Spaces	Reception/ entrance				109	78
	Conference room				107	77
	Office space with fixed workstations				98	71
	Kitchen				98	71
	Informal/ social meeting space				95	68
	Storage room				85	61
	Coffee corner				80	57
	Office space with shared/flexible workplaces				78	56
	Project, creative- or classroom				60	43
	Space for copy, print, mail etc.				59	42
	Office space with fixed and shared workplaces				55	39
	Atelier space				46	33
	Business hall/ unit				37	27
	Concentration room /study room				34	25
	Showroom				25	18
	Laboratory space				15	11
		Min.	Max.	Mean		SD
physical	Minimal rented surface in m^2	0	5530	89.03		499.95
	GFA in m^2	94	110000	9344.79		15281.64
	Vacancy in m^2	0	27000	1861.93		3815.23
	Year of construction	1889	2014	1972		33.59
	# Years as a business center	0	45	9.5		8.99
	# Different spaces	0	16	8		3.32
	# Tenants	0	350	39		52.37

3.3 Results

3.3.1 Objectives and business model

Table 8 shows the differences between the business center concepts regarding the objectives and the business model. Findings on the objectives of the business center concepts show several significant results between a regular business center compared to the other business center concepts. No significant difference was found between a regular business center and the other business center concepts with regard the objective 'to offer office space'. This is because all the business center concepts offer office space, which was to be expected. In addition to the objectives 'to offer office space', 'to stimulate knowledge transfer' and 'other objectives', significant results were found of a serviced office with all the other objectives related to a serviced office. Significantly negative differences were found

between serviced offices and the other concepts with regard to the objectives 'to stimulate local employment, 'to stimulate economic development and 'to support and facilitate start-up enterprises'. These findings suggest that serviced offices have less of these objectives than other business center concepts.

Regarding the findings of the analysis between a coworking office and the other business center concepts, positive significant differences were found with regard to the objectives 'to stimulate knowledge transfer' and 'to create a working community'. Leforestier (2009) also suggested that the objective of a coworking space is to stimulate social interactions and networking between tenants. Moreover, coworking offices appear to offer a community-driven environment that stimulates collaboration among tenants (Fuzi et al., 2014; Sykes, 2014).

With regard to the objectives 'to offer shared facilities and services', 'to offer full-fitted office space' and 'to offer managed technology', significant differences (negative) were found between incubators and the other business center concepts. This suggests that incubators do not have these objectives. These findings are not in line with Chen et al. (2006), who suggested that incubators offer 'software' services (providing techniques, organizing and managerial knowledge) and 'hardware' services (space, facilities and technology); similarly, Mian (1996) argued that one of the key services of an incubator are shared facilities and services. On the other hand, with regard to the objectives 'to support and facilitate start-up enterprises' and 'to stimulate economic development or growth in the region' (using Fisher's Exact Test), positive differences were found between incubators and the other concepts. These findings are in line with the extant literature on incubators (e.g., Lesáková, 2012; Aernoudt, 2004; Peters et al., 2004). Findings with regard to the business model (profit oriented/non-profit oriented) suggest that incubators and other business centers are mostly non-profit oriented and serviced offices are mostly profit oriented.

Table 8. Objectives and business model

Positive / Negative	Business center concepts				
N	35	45	12	14	17
Variables	Regular business center	Serviced office	Coworking office	Incubator	Other business center concept
To offer shared facilities and services	χ²=18.72** κ=-0.26	χ²=20.99** κ=0.31		χ²=8.74** κ=-0.12	
To offer office space with flexible terms		χ²=7.15** κ= 0.165			
To offer full-fitted office space	χ²=16.92** κ=-0.33	χ²=24.93** κ=0.42		χ²=6.85** κ=-0.17	
To offer managed technology	χ²=13.49** κ=-0.30	χ²=20.77** κ=0.38		χ²=5.44* κ=-0.16	
Creating a work community	χ²=30.18** κ=-0.35	χ²=7.09** κ=0.19	χ²=7.11** κ=0.13		
To support and facilitate start-up enterprises		χ²=15.20** κ=-0.32		χ²=10.28** κ=0.19	
Stimulate local employment		χ²=11.40** κ=-0.28			χ²=5.40* κ= 0.19
Stimulate knowledge transfer	χ²=22.56** κ=-0.36		χ²=4.44* κ=0.13		χ²=8.62** κ=0.20
Stimulate economic development and growth in the region	χ²=4.01* κ=-0.17	χ²=6.57* κ=-0.22		κ= 0.234**	
Business model		χ²=15.19** κ=-0.33		κ=0.309**	χ²=10.66** κ=0.27

Significant at the 0.05 level (2-tailed)

**Significant at the 0.01 level (2-tailed)

3.3.2 Tenants

Table 9 shows the significant differences between the different types of business center concepts with regard to the tenants' variables (target groups, lease contracts, atmosphere and the number of tenants). There is no significant difference between the business center concepts with regard to the number of tenants and the atmosphere. With regard to the target groups, the analyses show significant results. As can be inferred from Table 9, a negative significant difference was found between a regular business center and the other concepts, with regard to independent workers. This finding suggests that independent workers tend not to be a key target group for regular business centers. In addition, significant differences were established between a serviced office and the other business center concept, with regard to self-employed people, independent workers and SMEs. These findings suggest that serviced offices focus on these target groups. No significant differences were found, with regard to the target groups, between a coworking office and the other business center concepts.

Differences were also found between an incubator and the other concepts with regard to SMEs (negative), start-up enterprises (positive) and large enterprises (negative). This suggests that incubators focus on start-up enterprises rather than SMEs or large enterprises, which is in line with the existing literature (e.g., Peña, 2004). Other business center concepts were found to be significantly different with regard to self-employed people (negative) and other target groups (positive). This suggests that other business centers focus more on other target groups and less on self-employed people.

Regarding lease contracts, negative significant difference were found between a regular business center and the other concepts with regard to a one hour, one day and a one month lease contract. This suggests that regular business centers do not offer these types of lease contracts. Positive significant differences were found regarding a two year and a five year lease contract. These findings suggest that regular business centers offer more often these two types of lease contracts compared to the other business center concepts. Significant differences were found between a serviced office and the other the business center concepts with regard to several types of lease contracts. These findings imply a serviced office offers more often a one hour lease contract, a one day lease contract, a one month lease contract or a lease contract for an indefinite period than other concepts.

Table 9. Tenants

Positive	Negative	Business center concepts				
N		35	45	12	14	17
Variables		Regular business center	Serviced office	Coworking office	Incubator	Other business center concept
Self-employed			χ^2= 4.17* κ= 0.12			χ^2=4.01* κ=-0.09
Independent workers		χ^2=9.28** κ=-0.25	χ^2=21.68** κ=0.39			
SMEs			χ^2=4.96* κ=0.13		κ= -0.08*	
Start-ups					κ=0.071*	
Large companies					χ^2=5.44* κ=-0.17	
Other target group						κ=0.21*
One hour lease contract		χ^2=11.8** κ=-0.29	χ^2=16.31** κ= 0.33			
One day lease contract		χ^2=9.85** κ=-0.27	χ^2=18.18** κ=0.36			
One month lease contract		χ^2=15.69** κ=-0.29	χ^2=32.40** κ=0.45		χ^2=9.05** κ=-0.16	
1 year lease contract		χ^2=4.77* κ=0.13			χ^2=4.72* κ=-0.09	
2 years lease contract		χ^2=7.98** κ=0.22			χ^2=4.88* κ=-0.14	χ^2=7.082** κ=-0.18
5 years lease contract		χ^2=9.23** κ=0.24				
Lease for an indefinite period			χ^2=14.38** κ=0.32			

Significant at the 0.05 level (2-tailed)

*Significant at the 0.01 level (2-tailed)

Regarding lease contracts, no significant differences were found between a coworking office and the other business center concepts. In addition, the results in Table 9 suggest that incubators less often offer a one hour, one day and a one month lease contract and more often a one year, two years and a five years lease contract than other business center concepts.

3.3.3 Facilities/services

As can been seen in Table 10, many significant results were found with regard the facilities/services offered by the business centers. Several negative differences were found between a regular business center and the other business center concepts. These findings suggest that a regular business centers offers a lower level of services than the other business center concepts. This is also recognized by the existing literature (e.g., Calder and Courtney, 1992; Troukens, 2001).

Serviced offices were found to have the highest level of services. Regarding all facilities/services, besides the consultancy services, cleaning and maintenance services and the other services, there is a positive significant difference between a serviced office and the other business center concepts. Here, Gibson and Lizieri (1999) stated that a serviced office offers a wide range of IT and secretarial services, whereas Peltier (2001) suggested a serviced office also offers business services.

Significant differences were found between a coworking office and the other concepts with regard to catering, the use of coffee and tea maker and with regard to more social services (networking events and workshops or lectures). These services stimulate networking and collaboration among tenants/users of the business centers, because they give people the opportunity to meet each other.

Negative significant differences were found between incubators and the other business center concepts with regard to business services, security and catering. This finding suggests that incubators provide a lower range of services compared to the other business center concepts. In addition, no differences were found with regard to consultancy services. However, it is recognized that business support services (e.g., business advice, entrepreneurial training and assistance services) are important for developing a successful enterprise (e.g., Al-Mubaraki and Busler, 2011; Peña, 2004). On the other hand, a positive significant difference was found between other business center concepts and the other four business center concepts with regard to consultancy services. This finding suggests that most other business centers offer

consultancy services. This may be related to the fact that most other business center concepts involve a combination of the four types of business centers.

Table 10. Facilities/services

Positive	Negative	Business center concepts				
N		35	45	12	14	17
Variables		Regular business center	Serviced office	Coworking office	Incubator	Other business center concept
Business services		χ^2=16.97** κ=-0.35	χ^2=24.31** κ=-0.41		κ=-0.16*	
Secretarial services		χ^2=26.32** κ=-0.38	χ^2=29.53** κ=0.44			
Security			χ^2=9.65** κ=0.20		χ^2=7.05** κ=-0.11	
Managed technology		χ^2=10.58** κ=-0.20	χ^2=16.15** κ=0.27			
Consultancy services		χ^2=7.26** κ=-0.23				κ=0.25**
Networking events		χ^2=31.66** κ=-0.43	χ^2=15.85** κ=0.32	χ^2=4.15* κ=0.12		
Workshops and lectures		χ^2=27.11** κ=-0.43	χ^2=12.74** κ=0.30	χ^2=4.26* κ=0.14		
Catering		χ^2=30.62** κ=-0.42	χ^2=26.98** κ=-0.42	χ^2=6.12** κ=0.15	χ^2=6.29** κ=-0.16	
Use of coffee/tea		χ^2=41.66** κ=-0.42	χ^2=26.98** κ=0.37	χ^2=7.76** κ=0.14		
Furniture		χ^2=18.19** κ=-0.33	χ^2=28.28** κ= 0.44			
Pay what you use principle		χ^2= 4.066* κ= -0.04	χ^2=11.71** κ= 0.08	χ^2=5.23* κ= 0.04	χ^2=7.58** κ=-0.04	

*Significant at the 0.05 level (2-tailed)

**Significant at the 0.01 level (2-tailed)

With regard to the 'pay what you use' principle, several significant differences were found between the business center concepts. These findings suggest that a regular business center and incubators offer less often facilities based on the pay what you use principle. Moreover, serviced offices and coworking offices offer more often facilities based on the pay what you use principle.

3.3.4   Spaces, type of property and capacity

Several negative significant results were found with regard to the types of spaces between a regular business center and the other business center concepts. These findings suggest that a regular business center offers less different types of spaces than the other concepts. Regarding serviced offices, findings of this study suggest that serviced offices offer more often an office space with fixed workstations, office space with shared/ flexible workplaces, a conference room, a kitchen and a coffee corner than the other business center concepts. Serviced offices do not offer atelier spaces or other spaces.

Regarding a an informal/social meeting space, space for copy, print, mail etc. and other spaces, positive significant differences were found between a coworking office and the other business center concepts. This finding suggests that coworking offices provide more social and collaborative spaces than the other business center concepts. No significant differences were found between an incubator and the other business center concepts. This is probably because of the low number of incubators in the sample. Other business center concepts were found to be significantly different in terms of atelier space, laboratory space, project, creative- or classroom and other spaces. This might suggest that other business center concepts offer more of these types of spaces than their counterparts. In addition, a significant difference was found between a regular business center (M=5.34; SD=2.34) and the other business center concepts (M=8.80; SD=3.15) with regard to the number of spaces and between a regular business center (M=1.60; SD=1.88) and the other concepts (M=3.64; SD=3.41) with regard to the number of shared spaces.

With regard to the total number of different spaces, a significant difference was found between a serviced office (M=8.89; SD=2.60) and the other concepts (M=7.47; SD=3.54) and between a coworking office (M=9.68; SD=3.82) and the other concepts (M=7.65; SD=3.17). These findings suggest that serviced offices, coworking offices and other types of business center concepts offer more types of different spaces than regular business centers or incubators.

Table 11. Spaces, type of property and capacity

Positive	Negative	Business center concepts				
N		35	45	12	14	17
Variables		Regular business center	Serviced office	Coworking office	Incubator	Other business center concept
Office space with fixed workstations		χ^2=8.19** κ=-0.16	χ^2=10.82** κ= 0.21			
Office space with shared/ flexible workspaces		χ^2=14.41** κ=-0.26	χ^2=21.69** κ=0.35			
Atelier space			χ^2=5.15* κ=-0.19			χ^2=6.83** κ=0.20
Laboratory space		κ=-0.18*				κ= 0.21*
Conference room		χ^2=10.39** κ=-0.16	χ^2=12.96** κ=0.20			
Informal/ social meeting space		χ^2=14.05** κ=-0.22		χ^2=7.09** κ=0.14		
Project-. creative- or classroom		χ^2=4.06* κ=-0.16				χ^2=5.46* κ=0.16
Space for copy/print. mail etc.		χ^2=15.19* κ=-0.31		χ^2=3.87** κ=0.13		
Kitchen		χ^2=10.82** κ=-0.18	χ^2=10.82** κ=0.21			
Coffee corner		χ^2=40.74** κ=-0.43	χ^2=30.67** κ=0.43			
Other space			χ^2=8.62** κ=-0.22	κ=0.30**		κ=0.24**

Significant at the 0.05 level (2-tailed)

**Significant at the 0.01 level (2-tailed)

Table 11. Continued

Positive	Negative	Business center concepts				
N		35	45	12	14	17
Variables		Regular business center	Serviced office	Coworking office	Incubator	Other business center concept
# Types of spaces		t=6.89**	t=-2.67**	t=-2.53*		
# Types of shared spaces		t=4.43**				
Year of construction			t=-2.46*			
# Years as a business center		t=-2.43*				

Significant at the 0.05 level (2-tailed)
**Significant at the 0.01 level (2-tailed)

As can been seen, Table 11 shows the results of the t-test analyses between the different business center concepts, the type of property (year of construction and number of years as a business center). A significant difference was found between a regular business center (M=12.67; SD=9.84) and the other business center concepts (M=8.46; SD=8.47), with regard to the number of years as a business center. This might suggest that regular business centers exist a longer time than other business center concepts. Another negative significant difference was found between a serviced office (M=1982; SD=31) and the other business center concepts (M=1967; SD=34) with regard to the year of construction. This finding suggests that serviced offices are mostly located in newer buildings than other business center concepts.

3.4 Conclusion

The aim of this study was to analyze the business center market and test if the existing classifications entail significantly different concepts. In addition, to understand the different types of business center concepts, the differences between the business center concepts with regard to the business center characteristics were analyzed.

This study points at many significant differences between business center concepts. *Regular business centers* appear to exist longer than the other business center concepts, have no specific objectives, offer mostly a one year, 2 year or a 5 year lease contract, offer a low number of different (shared) spaces, and have a low service level.

Serviced offices are mostly newer business centers, for profit oriented, have many objectives, are oriented on SMEs, self-employed people and independent workers, offer a lot of different (shared) spaces, have a high service level, mostly based on a 'pay as you use' principle and offer workspaces based on a one hour, one day or one month lease contract.

Coworking offices have the objective to stimulate knowledge transfer and to create a working community. These offices offer social and collaborative spaces, mostly based on a one-year lease contract, have a high number of different spaces and offer catering and the use of coffee and tea makers.

Incubators appear to be mostly nonprofit oriented, have as objectives to support and facilitate start-up enterprises and to stimulate economic development and growth in the region, and are focused on start-up enterprises.

Thus, the analyses show that the four concepts of business centers in the literature also exist in the market and indeed have unique selling points to attract tenants. However, the results did not show significant differences with regard to the number of tenants, the informal atmosphere, spaces (concentration room, reception/ entrance, storage room, showroom, business units and office space with fixed and shared workplaces), minimal rented surface and the GFA. So, with regard to the physical part of the concepts all business centers are rather uniform and can be offered in similar objects. Therefore, owners/managers must differentiate themselves on the characteristics that make their concept unique (services, contract types or social spaces) and emphasize these in marketing and branding activities.

Surprisingly, less significant differences were found between an incubator and the other business center concepts than was expected. For example, incubators were not found to be significantly different with regard to the objectives 'to offer full-fitted office space' and 'to offer managed technology', laboratory space, project-, creative- or classroom and business- or consultancy services. This might be due to the low number of incubators in the dataset, compared to the other business center concepts, but also could indicate a shift in the entire market towards offering more complete and holistic concepts. This makes it difficult for incubators to profile themselves, because their role

(to provide a complete concept to help and support start-up enterprises) is taken over by the other concepts. Owners/managers of incubators could rethink their role (as most are non-profit organizations) and how they can still add to reaching their specific goals of stimulating start-up enterprises in certain sectors by offering more unique services and facilities (e.g., laboratory space, consulting services, networking opportunities and access to capital).

Findings suggest that more and more owners/managers recognize the social importance of business centers for tenants. Therefore, a growing number of business centers (e.g., coworking spaces) focus on creating a work community and offering social services, facilities and spaces. Occupancy rates in this sample show that coworking spaces have a lower occupancy rate compared to regular business centers and serviced offices. This suggests that coworking spaces have increased in popularity. These findings are in line with existing literature that suggests that there is a growing demand for other spaces than just a regular office space (e.g., informal meeting areas, project spaces and event spaces) (Harris, 2015).

Business center owners/managers who are dealing with vacancy problems or consider refurbishments could improve their business center by offering a more extended concept, with aspects that make their concept unique (e.g., atelier spaces, project- and creative spaces, laboratory spaces, consultancy services). As this study showed, this should not demand big changes in the physical presence of the building itself, and thus should be fairly easy. Furthermore, developers and investors, who have the ambition or goal to stimulate knowledge sharing among organizations, could use findings of this study to make well-informed decisions about new business centers that they want to develop or invest in to increase tenant retention.

Although business centers have become an important sector of the property market, there is hardly any empirical research on this sector. The results of this study provide more insight into the business center sector, which could be useful to academic researchers in this area. Findings of the analyses on the other reported business center concepts (e.g., not belonging to the four general types in literature) show several significant differences, such as an atelier space, laboratory space, project-, creative- or classroom and consultancy services.

4

Perceived networking and knowledge sharing behavior in business centers[2]

[2]This chapter is based on:

Weijs-Perrée, M., Appel-Meulenbroek, H.A.J.A., De Vries, B., and Romme, A.G.L. (2016). Networking behavior and knowledge sharing in business centers. In Brendan Galbraith and Sandra Moffett (Eds.), *17th European Conference on Knowledge Management*, Belfast, UK, 1-2 September 2016 (pp. 966-975). Reading: Academic Conferences and Publishing International Limited.

Weijs-Perrée, M., Appel-Meulenbroek, H.A.J.A., Arentze, T.A., and Romme, A.G.L. (Accepted/In press). The influence of the physical work environment on perceived networking and knowledge sharing behavior in business centers. *Intelligent Buildings International.* doi: 10.1080/17508975.2019.1574705

Weijs-Perrée, M., Appel-Meulenbroek, H.A.J.A., Arentze, T.A., and Romme, A.G.L. (2019). The influence of personal- and business centre characteristics on knowledge sharing types in business centres. *Facilities,* 37(1/2), 21-37. doi: 10.1108/F-07-2017-0064

4.1 Introduction

The review of the relevant literature in Chapter 2 showed that the network (size) and the strength of network ties (frequency of social interactions) are important for knowledge sharing. Most studies analyzed only the influence of networking behavior on knowledge sharing. When people share more knowledge, they also have a larger network size and more frequently interact with other people. Also, it is argued that knowledge sharing is influenced by several individual characteristics (i.e., demographics and personality), organization type/size, the use of offered services (i.e., non-physical characteristics of business centers) and characteristics of the physical work environment of business centers, and mediated by social networking behavior. Although many relations have been recognized by previous research, these relations have not been considered at the scale of a business center, where organizations share spaces, facilities and services.

In the first section, the data collection instrument, method and procedure are described. Next, in the third section of Chapter 4, the relation between business center concepts, organization type, personal characteristics, social networking and knowledge sharing is analyzed. The results showed that non-physical business center characteristics were less important (i.e., not significant) than physical characteristics for perceived social networking and knowledge sharing. Therefore, these non-physical characteristics were excluded from the model. In section 4, a model was tested with only non-physical characteristics and personal characteristics as independent variables and social networking and knowledge sharing as dependent variables. Next, the influence on the types of knowledge that is shared, based on the form and ownership of knowledge, was analyzed followed by the conclusion of this chapter.

4.2 Data collection and sample

Data was collected between January and February 2016 in 53 business centers in the Netherlands. First, an email was sent to all owners/managers of 139 business centers who participated in a previous study, asking whether they were willing to distribute the questionnaire among their tenants. Next, these tenants (organizations) were subsequently asked to distribute the questionnaire among their employees (business center users). Because the response was very low (177 business center users filled in a questionnaire), users of several business centers were asked in person to fill in the questionnaire (online or paper-pencil). Overall, 299 questionnaires were completed. However, several business center users did not fill in the questions on

knowledge sharing behavior, networking and facilities. These respondents were removed from the dataset, which resulted in a total of 268 useful questionnaires.

Table 12, Table 13, Table 14 show an overview of the variables measured. Open and multiple choice questions were asked about the personal- and work related characteristics (i.e., age, gender, education level, work situation, number of business club memberships, organizational type, number of hours working at the business center per week, work experience at the business center). Table 15 shows the distributions in the sample in terms of these characteristics. As can be seen, men (68%) are overrepresented in this research. The age of the respondents on average is 40 years. The gross annual income is equally divided over the three categories. A relatively high number (32%) of respondents has a gross annual income of more than €50.000. This is also related to the high number of respondents that have a higher educational level (undergraduate or post graduate). Most respondents in the sample, work as a freelancer (30%) or work at a SME (39%). Only a small percentage of the respondents (8%) work at a large enterprise. Most respondents work on a fulltime basis (40%). On average, respondents work at the business center for 3.63 years and spend 33 hours a week at the business centers. The mean number of business club memberships is 1.16.

Personality was measured based on the Five Factor Model (extraversion, agreeableness, conscientiousness, emotional stability and openness), using the Ten-Item Personality Inventory (TIPI) (Goslin et al., 2003). Respondents were asked to indicate if they agree with ten personality traits, ranging from (1) strongly disagree, to (7) strongly agree.

Different types of knowledge sharing were measured based on whether knowledge is codified (i.e., documented in some form) or un-codified (i.e., not documented in any form) and whether knowledge is private (not publicly available or guaranteed by third parties) or public (available and verifiable through third parties) (Marouf, 2007). Respondents were asked to indicate how frequent they shared the four types of knowledge that were distinguished. The questions on the four types of knowledge are formulated as:

- How many times do you ask your colleagues/other people for advice if you need help with a particular skill or competence for your work? (Public non-codified knowledge)
- How many times do you exchange documents with colleagues/other people? (e.g., notes, reports or annual reports) (Public codified knowledge)
- How many times do you share your expertise in face-to-face interactions or telephone conversations with colleagues/other people? (Private non-codified knowledge)

-   How many times do you share your expertise through other ways with colleagues/other people? (e.g., e-mail, notes, letters, instant messaging) (Private codified knowledge)

In addition, the frequency of shared knowledge with colleagues and with people from other organizations in the business center was asked. Respondents could respond to these questions on a 7-point Likert scale, ranging from (1) never to (7) multiple times a day. The internal consistency of the four types of knowledge sharing behavior with colleagues (Cronbach's Alpha of 0.951) and with others (Cronbach's Alpha of 0.921) is high in this study. Therefore, the sum scores of the four types of knowledge sharing behavior with colleagues and knowledge sharing with people from other organizations in the business center was used.

Research has shown that knowledge is shared during interactions (networking) between individuals. Therefore, in this study networking is measured using the frequency respondents having a social or business interaction with colleagues and other people in the business center. Networking was also measured on a 7-point Likert scale, ranging from (1) never to (7) multiple times a day. In the analyses, the sum scores of the frequency of social and business interactions with colleagues and social and business interactions with people from other organizations were used. The Cronbach's Alpha of (social- and business) interactions with colleagues is 0.882 and with others is 0.678. Furthermore, to capture network size, respondents were asked to indicate their perceived size of their social and business network, ranging from very small (1) to very large (7). A total score was used, to measure the perceived network size (social and business network).

With regard to workspace type and use, respondents were asked in which type of workspace they mostly work in the business center and how they use this workspace. With regard to workspace type, respondents could choose from the following four categories: alone in a closed space, together with others in a closed space, an open space without partitions or an open space with partitions. Furthermore, respondents could choose from the following three workspace use categories adapted from Van Meel (2000) namely a personal office (workspace is used by one person), dedicated shared office (workspace is shared by two or more fixed users) and flexibly used office (non-territorial workspace that is freely used by employees).

Respondents were also asked about the availability of several shared facilities/spaces, which showed that the following percentages of respondents had access to a showroom (8%), fitness/gym (14%), laboratory space (18%), business unit (19%) atelier space (23%), project-, creative-, classroom (32%), concentration room

(34%), storage space (36%), common terrace (38%), lounge space (40%), event space (50%), print/copy areas (52%), coffee corner (55%), informal- or social meeting space (66%), kitchen (70%), restaurant/canteen (72%), elevator (72%), reception (74%) and meeting space (78%). If the facility was available in the business center, respondents were asked about the frequency they use these facilities on a 7-point Likert scale ranging from (1) never to (7) multiple times a day. If a facility was not available in the business center, the frequency of using a facility was reported as 0 (never).

Next, the use of shared services was measured by asking respondents about if they use (i.e., yes or no) several services, namely business services (3%), secretarial services (35%), managed technology (3%), advisory services (3%), networking events (30%), workshops and lectures (14%), catering (26%), the use of coffee and tea facilities (40%) and furniture,(15%) in the business center. If the service was not offered by the business center, the use of the service was reported as 0 (no).

Table 12. Measures of personal and work-related characteristics

	Measurement level	Categories
Personal characteristics		
Age	Ratio	
Gender	Nominal	(1) Male (2) Female
Education level	Ordinal	(1) Secondary or vocational education (2) Undergraduate (3) Postgraduate
Income	Ordinal	(1) Low income (< € 30.000) (2) Moderate income (€ 30.000 - € 50.000) (3) High income (> € 50.000)
Personality Ten-Item Personality Inventory- (TIPI) (Goslin et al., 2003) I see myself as: 1. Extraverted, enthusiastic 2. Critical, quarrelsome. 3. Dependable, self-disciplined. 4. Anxious, easily upset. 5. Open to new experience 6. Reserved, quiet. 7. Sympathetic, warm 8. Disorganized, careless 9. Calm, emotionally stable. 10. Conventional, uncreative	Ordinal	(1) strongly disagree (2) moderately disagree (3) disagree a little (4) neither agree or disagree (5) agree a little (6) moderately agree (7) strongly agree (scoring "R" denotes reverse-scored items: Extraversion: 1, 6R; Agreeableness: 2R, 7; Conscientiousness; 3, 8R; Emotional Stability: 4R, 9; Openness to Experiences: 5, 10R)
Work-related characteristics		
Organization type	Nominal	(1) Freelancer (2) Small and medium-sized enterprises (3) Start-up enterprises (4) Large enterprise (5) Other, namely:
Work situation	Nominal	(1) Fulltime employee (2) Part-time employee (3) On a project basis (4) Student (5) Not applicable
# Years working at the BC	Ratio	
# Hours spent in the BC	Ratio	
# Business club memberships	Ratio	

Table 13. Measures of business center characteristics

	Measurement level	Categories
Physical work environment characteristics		
Workspace type (adapted from Van Meel 2000; Binyaseen 2010; Chusid 2001)	Nominal	(1) Individual closed workspace (2) Together with others in a closed workspace (3) Together with others in an open workspace without partitions (4) Together with others in an open workspace with partitions
Workspace use (adapted from Van Meel, 2000)	Nominal	(1) A personal fixed workspace (2) A shared fixed work space (3) A non-territorial workspace
Business center facilities		
Frequency of using business center facilities (adapted from Weijs-Perrée et al. 2016): a kitchen, print/copy area, elevator, coffee corner, meeting space/conference room, restaurant/canteen, informal/social meeting space, concentration room, common terrace, lounge room, event space, project-, creative- or classroom, business unit, laboratory space, fitness/gym, showroom, storage space and an atelier space	Ordinal	(1) Never (2) Less than once a month (3) Once a month (4) Once a week (5) Multiple times a week (6) (almost) Daily (7) Multiple times a day
Business center services		
Using the following services (adapted from Weijs-Perrée et al., 2016): business services, secretarial services, cleaning and maintenance, security, managed technology, advisory services, networking events, workshops and lectures, catering, the use of coffee/tea facilities and furniture	Nominal	(1) Yes (0) No/ not available

Table 14. Measures of social networking and knowledge sharing in business centers (adapted from Marouf, 2007)

	Measurement level	Categories
Social networking with colleagues	Ordinal	(1) Never (2) Less than once a month (3) Once a month (4) Once a week (5) Multiple times a week (6) (almost) Daily (7) Multiple times a day
Frequency of having a social interaction		
Social networking with people from other organizations		
Frequency of having a social interaction		
Knowledge sharing with colleagues	Ordinal	(1) Never (2) Less than once a month (3) Once a month (4) Once a week (5) Multiple times a week (6) (almost) Daily (7) Multiple times a day
Frequency of asking for advice if you need help with a particular skill or competence for your work (Public non-codified knowledge)		
Frequency of exchanging documents (e.g., notes, reports or annual reports) (Public codified knowledge)		
Frequency of sharing your expertise in face-to-face interactions (Private non-codified knowledge)		
Frequency of sharing your expertise through other ways (e.g., e-mail, notes, letters, instant messaging) (Private codified knowledge)		
Knowledge sharing with people from other organizations		
Frequency of asking for advice if you need help with a particular skill or competence for your work. (Public non-codified knowledge)		
Frequency of exchanging documents (e.g., notes, reports or annual reports) (Public codified knowledge)		
Frequency of sharing your expertise in face-to-face interactions (Private non-codified knowledge)		
Frequency of sharing your expertise through other ways (e.g., e-mail, notes, letters, instant messaging) (Private codified knowledge)		

Table 15. Sample characteristics (N=268)

	Sample (N)	Sample (%)	Mean	St. Dev.
Age	267		40.32	12.033
Gender				
Male	181	68		
Female	87	32		
Gross annual Income				
Low income (< € 30.000)	89	33		
Moderate income (€ 30.000 – € 50.000)	71	27		
High income (> € 50.000)	87	32		
(Missing)	21	8		
Education level				
Secondary or vocational education	54	20		
Undergraduate	139	52		
Postgraduate	75	28		
Work situation				
Fulltime employee	108	40		
Part-time employee	36	13		
Works on a project basis or student	30	11		
Not applicable	94	35		
Organization type				
Freelancer	80	30		
Small and medium-sized enterprises	106	39		
Start-up enterprises	41	15		
Large enterprise	21	8		
Other	20	8		
# Years working at the business center	234		3.63	4.577
# Hours spent in the business center	268		32.96	11.966
# Business club memberships	268		1.16	1.436

4.3 The influence of the physical work environment on social networking and knowledge sharing in business centers

The reviewed literature in Chapter 2 indicates that demographics (e.g., age, gender, work experience and education level), organization type, facilities (e.g., meeting spaces, reception, canteen/restaurant, kitchen, lounge and coffee area) as well as workspace type (i.e., alone in a closed space, together with others in a closed space or in an open space) and its use (i.e., personal office, shared office and the flexible used office) influence networking and knowledge sharing behavior in single tenant buildings. However, these studies have not considered these factors simultaneously in a single model or analyzed these relations in multi-tenant buildings, where organizations share facilities and office space. Based on previous research in single-tenant offices, it is assumed that the physical work environment (i.e., workspace type or use and the use of offered shared facilities) in business centers may have a direct or indirect effect (mediated by social networking) on knowledge sharing behavior with colleagues and with people from other organizations (e.g., Staplehurst and Ragsdell, 2010; Van der Voordt and Van Meel, 2000; Kastelein, 2014). Furthermore, in this study it is assumed that personal characteristics (e.g., age, gender, education level) and organization type, as control variables, have a direct and indirect effect on knowledge sharing behavior (e.g., Klyver and Grant, 2010; Pangil and Nadurdin, 2008; Zengyu Huang et al., 2013). Finally, it is expected that social networking behavior is critical for knowledge sharing behavior.

4.3.1 Methodology and results

To analyze simultaneously the effects of workspace type and use, facilities and demographics on networking and knowledge sharing behavior, and the effects between networking and knowledge sharing behavior, a path analysis was used. The Likert scales and sum scores are treated as interval-scale variables. Table 16 shows the distributions of the sample on the independent and dependent variables that were used in the path analysis. Regarding the frequency of using offered facilities, respondents use a kitchen, print/copy area, elevator and coffee corner most frequently. An atelier space, event space, common terrace, lounge room and a concentration room were used less frequently than other facilities. In addition, almost half of the respondents work together with others in a closed space, 31% works alone in a closed space and 24% works in an open space. Most respondents (79%) have a personal workspace.

As expected, respondents in this sample interact or share knowledge with colleagues more frequently than with people from other organizations in business centers

Table 16. Variables considered in the analyses (N=268)

	Mean	St. Dev.
Frequency of using offered facilities in a business center: (1) never to (7) multiple times a day		
Kitchen	3.94	2.522
Print/copy area	3.86	2.489
Elevator	3.53	2.611
Coffee corner	3.32	2.641
Meeting space/conference room	2.84	1.802
Restaurant/canteen	2.72	1.783
Informal-/social meeting space	2.47	1.871
Concentration room	1.60	1.284
Common terrace	1.58	1.048
Lounge room	1.56	1.278
Event space	1.49	1.007
Project-, creative- or classroom	1.41	1.120
Atelier space	1.23	0.938
Workspace type (Yes=1, No=0)		
Individual workspace (alone in a closed space) (dummy)	0.31	0.462
Together with others in a closed space (dummy)	0.45	0.500
An open space without partitions (dummy)	0.20	0.399
An open space with partitions (dummy)	0.04	0.190
Workspace use (Yes=1, No=0)		
A personal workspace (dummy)	0.79	0.410
Workspace on rotation basis (dummy)	0.12	0.329
Flexible used workspace (dummy)	0.09	0.286
Social networking with (Frequency of social interactions: (1) never to (7) multiple times a day)		
Colleagues	5.23	2.079
Others	3.93	1.804
Knowledge sharing (sum score frequency of sharing public non-codified knowledge, private non-codified knowledge, public codified knowledge and private codified knowledge)		
Colleagues	4.45	2.001
Others	2.01	1.135

To simultaneously analyze the hypothesized effects of the physical work environment (i.e., workspace type and use and facilities) on social networking and knowledge sharing behavior and the effects between social networking and knowledge sharing behavior, while controlling for demographics and organizational size, a path analysis was used. A path analysis is an extension of multiple regression analysis and a

special form of structural equation modelling that only includes observed or measured variables. A major advantage of path analysis, compared to ordinary multiple regression analysis, is that it can estimate direct and indirect effects simultaneously (Streiner, 2005). To estimate the path model, the statistical software package LISREL (Jöreskog and Sörbom, 2008) was used. The variables that were expected to have a significant effect on the frequency of interaction and knowledge sharing behavior (based on bivariate analyses, see Table 17 and Table 18) were added to the model. In addition, relations between independent and dependent variables and relations between dependent variables were added to the model. All links that were not significant at the 0.05 level (t <1.96) were then removed stepwise from the model. For example, variables such as using services in a business center, years working in the business center, hours working in a business center, using an informal meeting/social space, project-, creative- or classroom, kitchen, coffee corner were removed from the model. These were eliminated to develop an efficient model that provides a good fit of the data. Although these eliminated variables showed at least one significant bivariate relation with another variable, this relation did not remain significant in the full model. This results in the final model discussed in the next section.

Goodness of fit of the model

There are several measures of model fit. Generally, a model provides a good fit of the data if the value of Chi Square divided by the degrees of freedom and the Normed Fit Index are close to 1 (Golob, 2001). For the present model, the values are 1.42 (Chi-square ratio) and 0.97 (NFI). The value of RMSEA needs to be (close to) 0; this model results in a RMSEA value of 0.040. In addition, the value of the model's Akaike information criterion (AIC) needs to be close to the value of saturated AIC (Golob, 2001). For the present model, the AIC value of 193.72 is close to the saturated AIC value of 210.00. Overall, it can be concluded that the model shows a good fit with the data. Figure 5 shows the final estimated path model with only the direct standardized significant effects.

Table 17. Significant results bivariate analyses social networking

	Frequency social interaction colleagues	Frequency social interaction other people
Personal characteristics		
Age	**	**
Men	**	
#Business club memberships		
Education level	**	
Work-related characteristics		
Organization type	**	*
#Hours working at BC	**	**
#Years working at BC	**	
Workspace type		
Individual workspace	**	
Together with others in a closed space	**	
An open space without partitions		
An open space with partitions	*	
Workspace use		
A personal workspace		
Workspace on rotation basis		
Flexible used workspace		
Facilities business center		
Kitchen		
Print/copy area		**
Elevator	**	
Coffee corner	**	
Meeting space/conference room	**	
Restaurant/canteen	**	**
Informal-/social meeting space	**	**
Concentration room	**	
Common terrace		
Lounge room	*	*
Event space	*	*
Project/creative-/classroom		
Atelier space		

* and ** indicate that the coefficient is significant at the 0.05 and 0.01 level

Table 18. Significant results bivariate analyses knowledge sharing

	Knowledge sharing with colleagues	Knowledge sharing with other people
Personal characteristics		
Age	**	
Men	**	*
#Business club memberships		**
Education level	**	
Work-related characteristics		
Organization type	**	
#Hours working at BC		
#Years working at BC	**	
Workspace type		
Individual workspace	**	
Together with others in a closed space	**	
An open space without partitions	**	
An open space with partitions		
Workspace use		
A personal workspace		**
Workspace on rotation basis		
Flexible used/ non-territorial workspace		**
Facilities business center		
Kitchen		
Print/copy area	**	**
Elevator	**	
Coffee corner	**	
Meeting space/conference room	**	**
Restaurant/canteen	**	**
Informal-/social meeting space	*	**
Concentration room	**	**
Common terrace		*
Lounge room	*	**
Event space		**
Project/creative/ classroom		**
Atelier space		**

* and ** indicate that the coefficient is significant at the 0.05 and 0.01 level

Table 19. Path analysis model estimates (unstandardized effects)

From	To							
	Knowledge Sharing (KS) colleagues		KS with others		Freq. social interaction colleagues		Freq. social interaction others	
	Direct	Total	Direct	Total	Direct	Total	Direct	Total
Effects between dependent variables								
KS colleagues			0.10	0.10				
t statistic			*3.10*	*3.10*				
KS other								
t statistic								
Freq. social interaction colleagues	0.46	0.46		0.08			0.20	0.20
t statistic	*10.37*	*10.37*		*4.50*			*3.86*	*3.86*
Freq. social interaction others			0.19	0.19				
t statistic			*6.01*	*6.01*				
Effects of demographics and organizational type								
Age		-0.03		-0.01	-0.06	-0.06		-0.01
t statistic		*-8.93*		*-3.82*	*-7.23*	*-7.23*		*-3.34*
Men		0.37		0.07	0.81	0.81		0.17
t statistic		*4.45*		*2.84*	*3.66*	*3.66*		*2.66*
Business club			0.11	0.11				
t statistic			*2.87*	*2.87*				
Freelancer	-1.44	-1.44	0.38	0.38			0.84	0.84
t statistic	*-7.11*	*-7.11*	*2.89*	*2.89*			*3.50*	*3.50*
Effects of key variables								
Event space			0.17	0.17				
t statistic			*2.90*	*2.90*				
Restaurant				0.04			0.20	0.20
t statistic				*2.89*			*3.29*	*3.29*
Meeting space	0.24	0.24		0.03	0.28	0.28		0.06
t statistic	*4.40*	*4.40*		*3.25*	*4.76*	*4.76*		*3.00*
Lounge room			0.24	0.24				
t statistic			*5.06*	*5.06*				
Individual workspace (dummy)	-0.50	-0.99		-0.14	-1.09	-1.09		-0.22
t statistic	*-4.20*	*-4.32*		*-3.21*	*-4.60*	*-4.60*		*-2.96*
Flexibly used (dummy)			0.58	0.58				
t statistic			*2.90*	*2.90*				
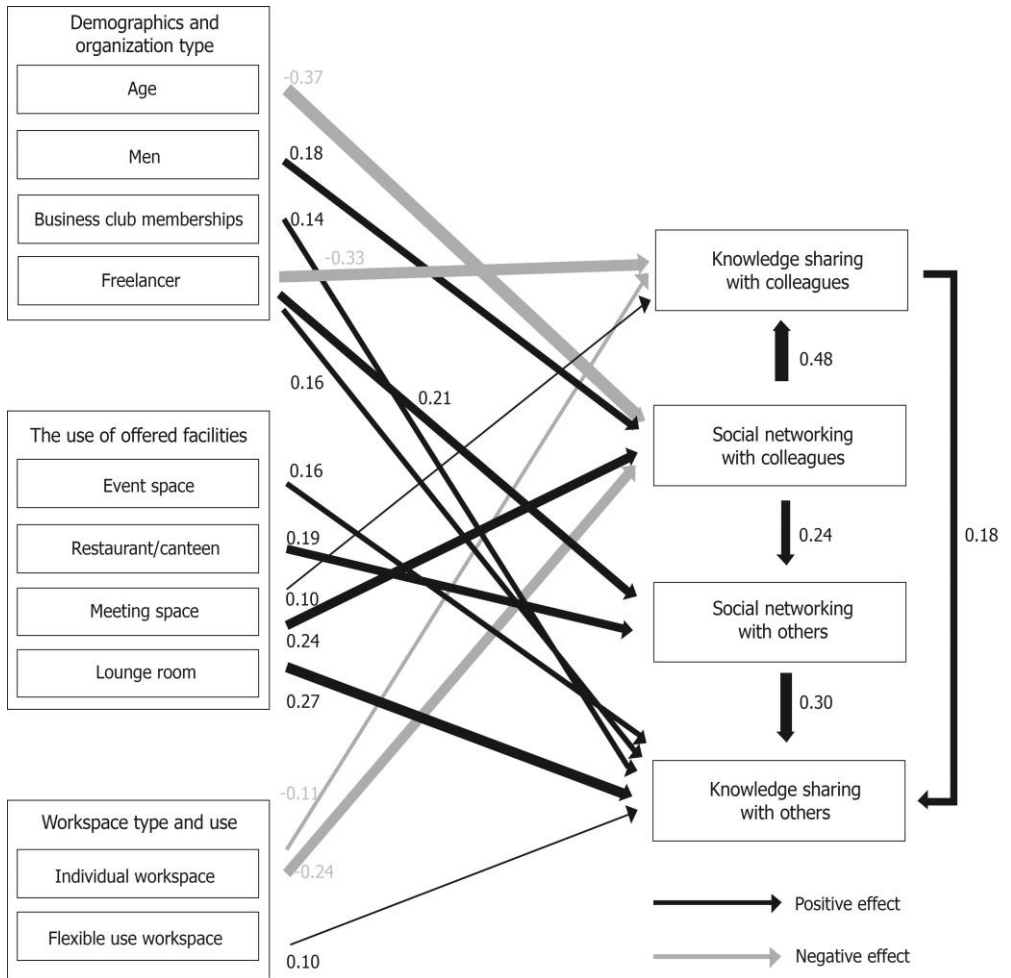
Figure 5. Significant standardized direct effects path analysis

Effects between social networking and knowledge sharing

Table 19 shows several direct and also indirect effects between social networking and knowledge sharing behavior with colleagues and others. It also shows the total standardized effects. First, frequency of social networking with colleagues was found to affect knowledge sharing behavior with colleagues. The same was found for social networking with others. This was expected, because knowledge sharing behavior tends to occur through social interactions (e.g., Wang and Noe, 2010). In addition, a direct significant effect of knowledge sharing with colleagues on knowledge sharing with people from other organizations was found. This suggests that people who share

knowledge with colleagues are also more likely to share knowledge with people from other organizations more frequently. With regard to the standardized effects, the results show that social networking with colleagues or people from other organizations has overall the largest standardized effect on knowledge sharing with colleagues ($\beta=0.48$) or with people from other organizations ($\beta=0.30$).

Effects of demographics and organizational type

With regard to demographics, age was found to have a significant negative direct effect on social networking with colleagues. This result suggests that older employees interact less with colleagues. Male employees were found to interact more with colleagues than female employees. Furthermore, as expected, people with more business club memberships more frequently share knowledge with others. The membership of an informal organization (club/association membership) could lead to relationships (networks), which are important resources for knowledge sharing behavior (Dodd and Patra, 2002). However, no relation was found between business club membership and social networking with others.

With regard to organization type, working as a freelancer was found to have a significant negative direct effect on social networking and knowledge sharing with colleagues and a significant positive effect on social networking with people from other organizations.

The results of the overall standardized effects of the demographics and organizational type in Table 19 show that age ($\beta=-0.37$) and gender ($\beta=0.18$) have the largest direct effect on social networking with colleagues. Working as a freelancer has a large direct effect on social networking with colleagues ($\beta=-0.21$) knowledge sharing with colleagues ($\beta=-0.33$) and a smaller direct effect on social networking with people from other organizations ($\beta=0.15$).

Effects of the physical work environment

As can be seen in Figure 5, facilities are highly important for knowledge sharing behavior and social networking with colleagues and others. Frequent use of a restaurant or canteen was found to have a significant positive effect on the number of interactions with others. Frequent use of a lounge room stimulates knowledge sharing behavior with others. This is also a place where people relax, and it provides opportunities to meet other people and share knowledge (Chevez and Aznavoorian, 2014).

Table 19 shows that the use of an event space has a direct effect on knowledge sharing behavior with others. The more frequently business center users use an event

space, the more frequently they share knowledge with people from other organizations. These event spaces are probably used for networking events organized by tenants or the business center manager. As expected, the use of a meeting space was found to positively affect social networking and knowledge sharing with colleagues only.

Besides facilities, the workspace is also important for knowledge sharing behavior and social networking with colleagues and others. Having an individual workspace (alone in a closed room) has a negative direct effect on knowledge sharing behavior with colleagues and a negative direct effect on social networking with colleagues. Moreover, having a flexibly used workspace has a positive effect on knowledge sharing behavior with other people in a business center. With regard to the standardized effects, the results show that an individual workspace ($\beta=-0.24$) and the use of meeting spaces ($\beta=0.24$) have the largest direct effect on social networking with colleagues. Using a lounge room has the largest effect ($\beta=0.27$) on knowledge sharing with people from other organizations. Other indirect or direct standardized effects on knowledge sharing with people from other organizations were found of a flexibly used workspace (i.e., non-territorial workspace) ($\beta=0.15$), using a restaurant/canteen ($\beta=0.06$), using a meeting space ($\beta=0.06$) and an individual closed workspace ($\beta=-0.06$).

Indirect effects mediated by social networking

With regard to the indirect effects, social networking with colleagues was found to be indirectly related to knowledge sharing behavior with others, mediated by social networking with people from other organizations. Apparently, people who have more interactions with colleagues have more interactions with people from other organizations as well and thus eventually share more knowledge with others. These people are probably more extravert and therefore, overall more willing to interact and share knowledge with others.

Furthermore, indirect effects were found of age on knowledge sharing behavior with colleagues and others and also on social networking with others, mediated by social networking with colleagues. Older employees interact less with colleagues and therefore probably share less knowledge than younger employees. Male employees indirectly more often share knowledge with colleagues and others, through social networking behavior.

In addition, an indirect significant positive effect on knowledge sharing with people from other organizations was found. This is expected, because freelancers mostly do not have colleagues to interact or share knowledge with, and therefore they

can only interact and share knowledge with people from other organizations in the business center.

With regard to the physical work environment, the use of a restaurant/canteen was also found to have an indirect effect on knowledge sharing behavior with others, mediated by social networking with others. A restaurant is an informal space, and this type of space allows people to relax and connect with other individuals. Furthermore, having an individual workspace (alone in a closed room) has a negative indirect effect on social networking and knowledge sharing behavior with others, mediated by social networking with colleagues.

4.3.2 Discussion

Organizations are increasingly acknowledging the need for work environments that stimulate knowledge sharing (Ives et al., 2000), as knowledge sharing increases the performance and innovativeness of individuals and organizations (e.g., Haas and Hansen, 2007). For users of business centers, the opportunity for social networking and knowledge sharing is also one of the aspects they mostly value (Ketting, 2014). Although business centers have become an important sector of the property market and several new business center concepts have been emerging, empirical research on this topic is still limited. With regard to social networking and knowledge sharing, previous research mainly focused on knowledge sharing within large organizations in single-tenant offices. Therefore, it is important to better understand the relationship between facilities shared by multiple organizations (as specific characteristic of a business center) and the perceived behavior in social networking and knowledge sharing within and between organizations.

Previous studies also showed that, besides physical characteristics, user demographics and organization type are additional drivers of social networking and knowledge sharing within a large organization. The aim of this study was therefore to analyze all of these effects on social networking and knowledge sharing within and between organizations. A second contribution to the literature is thus that all antecedents are simultaneously tested in a holistic model, looking at perceived knowledge sharing within as well as between organizations. This way, similarities and differences in the effects on both important sources for knowledge sharing are uncovered, plus the interrelationship between knowledge sharing and social networking.

The results showed several new insights in the relation between the physical work environment of business centers and knowledge sharing behavior. The final path model, for example, showed that the use of several facilities directly or indirectly

influences knowledge sharing within and between organizations, mediated by social networking with colleagues and others. Especially a variety of facilities for formal and informal meetings was found to positively influence people's social networking behavior or sharing knowledge, namely a restaurant/canteen, event space, lounge room and a meeting space. This is in line with previous research in single-tenant offices by Peponis et al. (2007), Kastelein (2014), Hua et al. (2011) and Staplehurst and Ragsdell (2010). Thus, business centers can focus more on social networking and knowledge sharing by offering a variety of meeting facilities, to attract innovative organizations that strive for more knowledge sharing. In addition, managers of these tenant organizations should also stimulate their employees to use these shared facilities. For example, by changing their work processes or activities into more collaborative and possible interactive work for which these type of spaces are needed. Further research is needed regarding the incentives for employees to use different workspaces and to share knowledge with colleagues or with people from other organizations.

This study showed that an individual closed workspace negatively influences social networking and knowledge sharing within organizations. Thus, the data support the relationship assumed between workspace type and social networking and knowledge sharing. Previous research also showed that a cellular office, whereby mostly individual non-shared workspaces are offered, compared to an open office (with low partitions), decreases the number of interactions between people (e.g., Blakstad et al., 2009; Binyaseen, 2010). An open work environment could increase trust among people, which could result in more willingness to share knowledge (e.g., Zagenczyk et al., 2008). In addition, people who are sitting close to each other and can see each other appear to have more interactions (Steen, 2009). Despite these advantages, working in a more open workspace has several disadvantages, such as more noise, reduced privacy and fewer opportunities to perform work that needs concentration (Van der Voordt and Van Meel, 2000; Blakstad et al., 2009). Therefore, a balanced physical work environment should be designed that facilitates different types of work activities that overcomes the disadvantages of open or closed work environments (Horr et al., 2016) based on the needs and preferences of individual users. This could improve the productivity and creativity of workers (Anjum et al., 2015). For example, a combination of open workspaces for social networking, meeting spaces for planned meetings and concentrations rooms for work that needs more concentration. This is also observed in a previous study by Lee (2016) who showed that a balanced spatial layout leads to a more effective workflow and interaction and collaborating, because the space is flexible and several different work activities (e.g., spaces for idea generation) are

accommodated. Business centers with only a cellular office structure probably do not stimulate knowledge sharing within and between organizations. Such office buildings are not optimally transformed to business centers and eventually might exhibit a high level of vacancy when tenants recognize that they are not getting what they expected.

With regard to the use of workspaces, this study offers evidence for the idea that having a flexible workspace increases knowledge sharing with other people in business centers. This is in line with previous studies of single tenant offices that showed that flexible workspaces influence interaction patterns (e.g., Van der Voordt and Van Meel, 2000). However, 79% of the respondents still have a fixed workspace. Thus, business center managers could provide more flexible spaces to stimulate knowledge sharing between their tenant organizations if these organizations and their employees are interested in and willing to work in such an environment. Although a more flexible use of the work environment increases interactions between people, this could also lead to problems, such as that people are not able to find a workspace or a specific person and it is more difficult to personalize the workspace (e.g., Kim et al. 2016). So it could also push tenants away, if they are unable to adapt their workstyle to a flexible work environment. Therefore, it is also important for owners/managers of business centers to gain insight in user preferences with regard to their work environment. They could adapt to specific preferences and create more attractive business centers with innovative hotspots (i.e., restaurant/canteen, informal meeting spaces, lounge spaces and event spaces) and flexible workspaces where people interact and eventually share knowledge. Although the design of a building can create an innovative setting, the individuals in the building also need to take initiatives to use the various facilities and contribute to sharing knowledge (e.g., Clements-Croome, 2015). In addition, it is also recognized that services offered by the business center (e.g., community membership, partnerships, networking events) are instrumental in increasing knowledge sharing within and between organizations (Petrulaitiene et al., 2017).

Furthermore, people who socially interact more with colleagues also appear to interact more with people from other organizations and therefore indirectly share more knowledge. This underlines the importance of social networking (i.e., social interactions) as a mediator for knowledge sharing within and between organizations, which was also observed in previous research conducted in larger organizations located in single tenant offices (e.g., Marouf and Doreian, 2010). For these interactive people, working in a business center is thus very important in acquiring external knowledge for their own organization. Innovative organizations should therefore stimulate this type of employees

to work (at least a part of their time) in a business center. Using the physical design of their buildings, business center managers are indeed able to increase people's efforts towards knowledge sharing and eventually the innovative capabilities of their tenants.

As expected, demographics such as age, gender and membership of a business association were found to have a large effect on social networking and knowledge sharing too. Older employees were found to share less knowledge with colleagues than younger employees. However, especially older workers are likely to have more valuable knowledge and work experience (Oye et al., 2013). Therefore, motivating older employees, for example by HR managers, to share their knowledge with others may be especially beneficial for the organization. By giving older employees a mentoring role, younger employees can learn from the knowledge and experiences of their more senior colleagues (Brčić and Mihelič, 2015). It is also recognized that reversed mentoring could help older employees to acquire technology-related skills from younger employees (Murphy, 2012). The model estimated in this study does not reveal the causes of this age effect.

The results showed that male workers socially interact more frequently than women and thus indirectly share knowledge more frequently with colleagues and other people in the business center. This is in line with previous research that showed that the business network (i.e., personally knowing other entrepreneurs) of female entrepreneurs is smaller than the networks of their male counterparts (Klyver and Grant, 2010). This finding can also be related to the fact that women are mostly in different job positions then men, whereby networking and knowledge sharing is less necessary (Ridgeway and Smith-Lovin, 1999). Another study showed that females are more willing to share knowledge if they frequently interact with this other person (i.e., strong tie) (Lin, 2006). Female workers, in higher job position (e.g., management function), should be made aware of the fact that they can get knowledge from people within their own organization or from people of other organizations in the business center.

Being a member of a business club is also important for knowledge sharing with people from other organizations. Previous research has also observed that the membership of a business club (or other organization) increases one's network (Dodd and Patra, 2002) and thus also the chance of sharing knowledge with others. As such, business center managers could stimulate their tenants to create a business club that organizes networking events, to stimulate interactions among tenants and eventually knowledge sharing.

4.3.3 Conclusion and limitations

Although this study showed that the physical work environment significantly influences knowledge sharing in business centers, earlier studies have concluded that knowledge sharing also depends on several other context variables such as trust (Levin and Cross, 2004), personality (Gupta, 2008), organizational culture (Xerri and Brunetto, 2010), structure (Chen and Huang, 2007), organizational size (Chevez and Aznavoorian, 2014), and technological context (Ismail and Yusof, 2010). In addition, several other relevant characteristics of the physical work environment were not included in this study: the distance between workspaces and facilities (e.g., Wineman et al., 2014), the actual lay-out of a business center, the exact location of facilities (e.g., distance to facilities), or the proximity between people. Including all these variables could result in a more comprehensive model that can be used to analyze knowledge sharing in business centers in more depth. In addition, using a larger dataset, also from different countries, would help to increase the generalizability of the results.

The path model simultaneously tests multiple expected direct and indirect effects. However, a limitation of cross-sectional analysis in general is that the model cannot establish the direction of causality. Therefore, statements about the causal direction of the effects cannot be made. In this respect, causal terms such as 'influence' and 'effect' are often used in this paper; but strictly speaking, these are merely causal interpretations of statistically significant relationships that may involve cause-effect relationships in both directions. For example, individuals that overall engage more frequently in social networking with others could also prefer a more open work environment, and vice versa. Although causal relations cannot be unambiguously determined, the analysis in this study nevertheless revealed interesting relationships between the physical work environment, social networking and knowledge sharing.

Furthermore, the results of this study showed some age differences with regard to knowledge sharing, and therefore future research also needs to conduct a more in-depth analysis of the differences between generations of workers (e.g., baby boom generation, generation x and generation y) with regard to knowledge sharing. Older workers may prefer social networking, and therefore knowledge sharing, in more traditional ways (e.g., face-to-face and by telephone), while younger workers are likely to prefer electronic communication (Brčić and Mihelič, 2015). Future research in this area also needs to explore whether gender differences exist in the motivation to share knowledge in business centers. Furthermore, more research is needed on how different types of interactions influence knowledge sharing behavior within and between

organizations in business centers, for example, by observing and analyzing real-time knowledge sharing behavior instead of perceived behavior.

Work style trends such as working from home and virtual working have been changing the work environment in many organizations towards a more social and interactive environment for face-to-face meetings, collaboration, social events and workshops (Johns and Gratton, 2013). Thus, the physical work environment in business centers is becoming more and more important for knowledge sharing, and should therefore be managed and planned in ways that help their residents become more successful (Wang and Noe, 2010).

Especially for business centers in which different organizations share spaces, facilities and services, more research is needed to investigate and determine the added value of business centers for knowledge sharing and other important user values. This study contributes to this knowledge gap by demonstrating the relationship between the physical work environment and perceived knowledge sharing between organizations located in a business center.

4.4 The influence of non-physical business center characteristics on networking and knowledge sharing

In the previous section, non-physical characteristics (i.e., use of offered services) were excluded from the model. These characteristics were not found to have a significant effect on networking and knowledge sharing. This suggested that physical characteristics are more important for knowledge sharing than non-physical characteristics. However, services (e.g., networking events and workshops) could also be important for stimulating social interactions among colleagues and non-colleagues. Therefore, the purpose of this study is to analyze the influence of the use of offered services on social networking and knowledge sharing in business centers, also controlled for demographics and personality factors.

4.4.1 Methodology and results

A path analysis is used in order to simultaneously analyze the effects of personal characteristics and the use of offered services on social networking behavior and knowledge sharing, as well as the effects between networking behavior and knowledge sharing by users of business centers (see Figure 6). The statistical software package LISREL (Jöreskog and Sörbom, 2008) was used to estimate the model.

The first step was to analyze the relationships separately between the independent and dependent variables, using bivariate analyses (see Table 21 and Table 22). The relationships that were found to be significant at the 0.05 level were entered in the path model. Also, links between the independent and dependent variables, as well as links between the dependent variables were added in the model. Links that were not significant at the 0.05 level were subsequently removed (stepwise) from the model. The endogenous and explanatory variables used in the final analysis are shown in Table 20. Table 23 shows the unstandardized coefficients and the t-statistics of the significant effects.

Table 20. Endogenous and explanatory variables considered in the analysis (N=268)

	Mean	St. Dev.
Endogenous variables		
Knowledge sharing colleagues	4.45	2.001
Knowledge sharing with other people	2.01	1.135
Networking behavior		
Perceived size of network in the business center	4.16	1.228
Frequency social interaction with colleagues	5.23	2.079
Frequency social interaction with other people	3.93	1.804
Explanatory variables		
Personal characteristics		
Age	40.32	12.033
Men (dummy)	0.68	0.469
Business club memberships	1.16	1.436
Low education level (dummy)	0.20	0.402
Hours working at the business center	32.96	11.966
Personality		
Extravert, enthusiastic	5.30	1.167
Traditional, uncreative	2.70	1.395
The use of services in business centers (Yes/No)		
Consultancy services (dummy)	0.03	0.180
Use of coffee and tea services (dummy)	0.40	0.490
Managed technology (dummy)	0.37	0.483

Table 21. Significant results bivariate analyses social networking

	Perceived network size	Frequency social interaction with colleagues	Frequency social interaction with other people
Personal characteristics			
Age		**	**
Men		**	
Education level	*	**	
# Business club memberships	**		
Work-related characteristics			
#Hours working		**	**
#Years working		**	
Personality			
Extraverted, enthusiastic	**		
Critical, quarrelsome			
Dependable, self-disciplined			
Anxious, easily upset			
Open to new experiences, complex	*		
Reserved, quiet	**		
Sympathetic, warm			
Disorganized, careless			*
Calm, emotionally stable			
Conventional, uncreative	*	**	
Services business center			
Business services	*		
Secretarial services			
Cleaning & maintenance			
Security			
Managed technology			
Consultancy services			
Networking events			**
Workshops & lectures			*
Catering	*		*
Use of coffee & tea			
Furniture			

* and ** indicate that the coefficient is significant at the 0.05 and 0.01 level

Table 22. Significant results bivariate analyses knowledge sharing

	Knowledge sharing with colleagues	Knowledge sharing with other people
Personal characteristics		
Age	**	
Men	**	*
#Business club memberships		**
Education level	**	
Work-related characteristics		
#Hours working		
#Years working	**	
Personality		
Extraverted, enthusiastic		
Critical, quarrelsome		
Dependable, self-disciplined		
Anxious, easily upset		
Open to new experiences, complex		
Reserved, quiet		
Sympathetic, warm		
Disorganized, careless		
Calm, emotionally stable		
Conventional, uncreative		**
Services business center		
Business services		*
Secretarial services		
Cleaning & maintenance	*	**
Security		*
Managed technology		*
Consultancy services		**
Networking events		**
Workshops & lectures		**
Catering		
Use of coffee & tea	*	
Furniture		

* and ** indicate that the coefficient is significant at the 0.05 and 0.01 level

Figure 6. Significant standardized direct effects path analysis

As can been seen in Table 24, the value of RMSEA is 0.043, and needs to be close to 0. The value of the model's Akaike information criterion (AIC) needs to be close to the value of saturated AIC (Golob, 2001). Also, the model provides a good fit of the data, if the value of Chi Square divided by the degrees of freedom and the Normed Fit Index are close to 1 (Golob, 2001). Table 24 shows that the Normed Fit Index is 0.91 and the value of Chi-square, divided by the degrees of freedom is 1.49. Thus, overall the model shows a good fit to the data.

Figure 6 shows the significant direct effects of the estimated final model. As can been seen, networking behavior (the frequency of social interactions with colleagues) was found to have a significant effect on knowledge sharing with colleagues. This is in line with previous studies that suggest that a higher frequency of social interactions

could lead to stronger ties and therefore to more knowledge sharing (Van Wijk, Jansen and Lyles, 2008). Knowledge sharing with colleagues significantly affects knowledge sharing with others in the business center. People who are more willing to share knowledge with colleagues probably also share more knowledge with others. The perceived network size (business- and social network) is affected by knowledge sharing with others. Greve and Salaff (2003) found that the size of the network could influence knowledge sharing. However, the results show no relations between network size and knowledge sharing with colleagues or others. Furthermore, no significant effect was found of knowledge sharing on the frequency of social interactions with colleagues or others.

Two explanatory variables were found to have an effect on knowledge sharing with others in the business center, namely using consultancy services (e.g., financial, marketing and legal services),and the personality trait 'conventional, uncreative'. People who use consultancy services that are offered by the business center, share more knowledge with others, than people who do not use these services. Note that the frequency of using services was not measured in this thesis. Another service that is offered by business centers, namely managed technology, was found to have an effect on knowledge sharing with colleagues.

As expected, people who identify more with the personality trait 'traditional, uncreative', less frequently share knowledge with others. This is in line with previous research (e.g., Cabrera et al., 2006). Furthermore, perceived network size is significantly affected by the personality trait 'extravert, enthusiastic'. These people are probably more willing to participate in network activities and therefore perceive to have a larger network. This is in line with Wolff and Kim (2012), who suggested that extraversion, could lead to more contacts.

The frequency of social interactions with colleagues is affected by several individual characteristics, namely age (negative), being male (positive), low education level (negative) and hours working at the business center (positive). This is somewhat in line with Zengyu Huang et al. (2013), who found that highly educated people more often use their network for advice, women more often use their personal network for advice instead of men and early stage entrepreneurs more often use their network for advice than later stage entrepreneurs. In addition, Klyver and Grant (2010) found that the entrepreneurial network is smaller for female entrepreneurs than for male entrepreneurs. Thus, women have a smaller business network and therefore probably have less business interactions. However, in this study the difference between personal (social) interactions and business interactions were not taken into account.

Table 23. Path analysis model estimates (unstandardized direct (D) and total (T) effects)

From	To									
	KS colleagues		KS others		Network size		Freq. social interaction colleagues		Freq. social interaction others	
	D	T	D	T	D	T	D	T	D	T
Effects between endogenous variables										
KS colleagues			0.06	0.06		0.02				
t statistic			*2.05*	*2.05*		*1.86*				
KS other					0.27	0.27				
t statistic					*4.29*	*4.30*				
Network size										
t statistic										
SI colleague	0.64	0.64		0.04		0.01				
t statistic	*17.21*	*17.21*		*2.04*		*1.85*				
SI others			0.36	0.36		0.10				
t statistic			*9.91*	*9.91*		*3.94*				
Effects of explanatory variables										
Age		-0.05		0.00		0.00	-0.07	-0.07		
t statistic		*-6.71*		*-1.97*		*-1.79*	*-7.32*	*-7.32*		
Men		0.84		0.05		0.01	1.32	1.32		
t statistic		*4.91*				*1.74*	*5.16*	*5.16*		
Business club				0.06		0.02				0.17
t statistic				*2.39*		*2.09*				*2.46*
Low education		-0.66		-0.04		-0.43	-0.99	-0.99		
t statistic		*-3.38*		*-1.76*		*-2.45*	*-3.32*	*-3.32*		
#Hours working		0.02		0.00		0.00	0.03	0.03		
t statistic		*2.81*		*1.66*		*1.55*	*2.85*	*2.85*		
Extravert					0.30	0.30				
t statistic					*4.95*	*4.95*				
Traditional			-0.10	-0.10		-0.03				
t statistic			*-2.49*	*-2.49*		*-2.16*				
Consultancy services			0.72	0.72		0.35				10.6
t statistic			*2.22*	*2.22*		*2.71*				*0.96*
Use of coffee/ tea				0.15		0.04			0.43	0.43
t statistic				*2.09*		*1.88*			*2.14*	*2.14*
Managed technology	0.38	0.38		0.02		0.01				
t statistic	*2.16*	*2.16*		*1.48*		*1.40*				

Table 24. The goodness-of-fit statistics of the model

Degrees of Freedom	44
Minimum Fit Function Chi Square	68.73
Chi Square / Degrees of Freedom	1.49
RMSEA	0.043
Model AIC	217.39
Saturated AIC	240.00
Normed Fit Index	0.91

4.4.2   Discussion and conclusion

The aim of this study was to analyze the relationships between individual characteristics, the use of services in business centers, networking behavior and knowledge sharing simultaneously in one model. Results of the path analyses show that especially individual characteristics (age, gender, education level, business club membership and hours working at business center), and networking behavior are important in explaining knowledge sharing between and within organizations in a business center. In line with previous research, findings suggest that extraverted people have a larger network size and traditional/uncreative people share less knowledge with others in the business centers. Organizations may steer their employees to become more extravert and creative by offering trainings or workshops and screen job applicants for their extraversion or creativity.

Furthermore, only consultancy services, managed technology and the use of coffee- and tea services were found to affect networking behavior (i.e., frequency of social interactions with other people in the business center) and knowledge sharing with colleagues and people from other organizations in business centers. Thus, for organizations it is important to find an office space in a business center that offers these services to increase networking behavior and knowledge sharing with other organizations. This is important to get access to new knowledge. The use of other services that were studied (e.g., networking events, catering, workshops/lectures or business services) were surprisingly not very relevant for improving networking behavior or knowledge sharing between or within organizations. On the other hand, the demand for office space in business centers with a higher service level is increasing (Weijs-Perrée et al., 2016). Therefore, business center owners/managers should offer these services, as unique selling points to attract tenants.

This study adds more understanding to knowledge sharing between and within organizations at the scale of a building, which received hardly any attention in existing literature. Findings show the importance of social interacting with colleagues for

knowledge sharing with colleagues and the importance of social interacting with others for knowledge sharing with others. Thus, social networking is important to get access to knowledge of colleagues and of other organizations. Also, the results show that the use of consultancy services, business club memberships, networking behavior and knowledge sharing are important for employees. Organizations should be aware of the influence of these factors and stimulate their employees to become a member of a business club and use these services, so they could share more knowledge with other people. Furthermore, for business centers it is important to organize events were employees of different organizations can interact and eventually share knowledge, to attract more tenants.

4.5 Sharing different types of knowledge in business centers

Knowledge sharing is a process whereby individuals mutually exchange knowledge. Understanding the knowledge sharing process, during which organizations share spaces, facilities and services, is highly important for owners/managers who seek to optimize their business center and to attract more innovative tenants. For users of business centers it is interesting to know how, where and what type of knowledge is shared. However, there is hardly any research into sharing different types of knowledge in business centers. The purpose of this section is to analyze the influence of personal- and organizational characteristics on sharing different types of knowledge within and between organizations in business centers.

4.5.1 Methodology and results

To simultaneously analyze the relations between different sets of personal- and business center characteristics (independent variables) and different types of knowledge sharing (as dependent variables) in a single model system, a seemingly unrelated regression analysis (SUR) was used. A SUR is used when multiple regression equations, with different dependent variables that are related to each other and different sets of independent variables, are analyzed at the same time (Sun et al., 2014). In this study, the equations with the four types of knowledge sharing as dependent variables are also related to each other. Therefore, SUR is a suitable method, as an extension of linear regression analysis that allows correlated errors between equations (Sun et al., 2014).

First, eight multiple regression analyses (stepwise) were performed. Based on these analyses, variables that were found to have a significant effect on the dependent variables were included in the SUR analysis. Variables that were not found to have a

significant effect in the multiple regression analyses were not included in the SUR (i.e., empty cells in Table 25 and Table 26).

The normal probability plot of the residuals of the regression analyses shows that most of the residuals are normally distributed. Some of the residuals are slightly skewed and therefore the results should be interpreted carefully. The results of the SUR (see Table 25 and Table 26) indicate that sharing the four types of knowledge is indeed influenced by personal characteristics, the frequency of using offered facilities/services and workspace characteristics. The regression sum of squares (SSR) measures how much of the total variation is explained by the regression. In addition, the mean square error (MSE) measures the fit to the data. The smaller the MSE, the better the model explains the data (Li, 2010).

The first model (i.e., knowledge sharing within organizations) has an adjusted R^2 of 0.307 for explaining the public non-codified knowledge, 0.332 for explaining public codified knowledge, 0.382 for explaining private non-codified knowledge and 0.337 for explaining private codified knowledge. Overall, the personal- and business center characteristics explain between 33.2% and 38.2% of the total variance of the types of knowledge sharing. In the second model (i.e., knowledge sharing between organizations), personal- and business center characteristics explain between 18.6% and 31.2% of the total variance of the types of knowledge sharing. Thus, probably other characteristics are important for explaining knowledge sharing between organizations than for sharing different types of knowledge within an organization. For example, differences in organizational culture (Xerri and Brunetto, 2010), structure (Chen and Huang, 2007) and size (Chevez and Aznavoorian, 2014) could also influence knowledge sharing between organizations.

Knowledge sharing within organizations

The results show that younger and male workers all positively influence sharing the four types of knowledge. Although it is recognized that older employees have more valuable knowledge and work experience to share (Oye et al., 2013), results showed that older employees share less frequently knowledge within their own organization. With regard to the physical work environment, the results show that frequently using a canteen (positive, except sharing public codified knowledge) and meeting space, and not having an individual closed workspace positively influence all types of knowledge sharing. Kastelein (2014) also showed that open and common workspaces, common shared areas (e.g., canteen or lounge space) and meeting spaces are the most important facilities for enabling interactions between colleagues. In

addition, meeting rooms appear to be one of the most important knowledge sharing facilities for SMEs (Staplehurst and Ragsdell, 2010).

Table 25. Results for knowledge sharing (KS) within organizations

	Public non-codified KS	Public codified KS	Private non-codified KS	Private codified KS
	Coeff.	*Coeff.*	*Coeff.*	*Coeff.*
Personal characteristics				
Age	-0.042**	-0.046**	-0.049**	-0.037**
Male	0.697**	1.147**	1.055**	1.111**
Low education				-0.452**
Hours working				
Start-up enterprise	-0.230	0.012		-0.423
Club membership				
Personality traits				
Traditional/uncreative				
Trustworthy/disciplined				
Sympathetic/warm		0.069	0.096	
Frequency of using an offered shared facility/service				
Lounge space				
Event space				
Canteen/restaurant	0.144*	0.117	0.167*	0.163*
Space for copying and printing			0.072*	
Meeting space	0.300**	0.326**	0.324**	0.338**
Project- or class room	-0.206**	-0.146		
Consultancy services				
Workspace characteristics				
Non-territorial workspace				
Individual closed workspace	-1.728**	-2.042**	-1.814**	-1.961**
R^2	0.325	0.352	0.398	0.354
Adjusted R^2	0.307	0.332	0.381	0.337
SSR (Regression Sum of Squares)	1034.948	1277.800	1063.315	1236.689
MSE (Mean Square Error)	3.980	4.936	4.090	4.757

* and ** indicate that the coefficient is significant at the 0.05 and 0.01 level

Table 25 shows that people who more frequently use a space for copying and printing share more private non-codified knowledge. It was known that an area for printing and copying stimulates unplanned encounters, for example when people are waiting for printouts (Hua et al., 2010). The results add to this previous work that also the particularly important private non-codified knowledge (Marouf, 2007) is more

frequently shared in printing/copying areas. The results also show that frequently using a project/classroom negatively influences the frequency of sharing public non-codified knowledge within organizations. These spaces are probably used for team meetings where privacy is necessary and thus more private non-codified knowledge is shared. However, no significant relation was found between sharing private knowledge and the use of a project- or classroom. Furthermore, knowledge sharing within organizations is not influenced by one of the personality traits. Typical business center facilities/services (e.g., lounge space, event space and consultancy services) were also not found to have a significant effect on knowledge sharing within organizations.

Knowledge sharing between organizations

As can be inferred from Table 26, freelancers share more public non-codified knowledge with people from other organizations than other user groups in the business center. Club membership increases the frequency of sharing private non-codified knowledge. With regard to personality, traditional or uncreative people less frequently share private non-codified knowledge with people from other organizations (e.g., beliefs, viewpoints, insights, and experiences). Previous studies also showed that people who are more open to new experiences are more willing to share knowledge (Matzler et al., 2008; Gharanjik and Azma, 2014). However, previous studies did not look into the influence of personality of business center users on sharing different types of knowledge. Furthermore, results show that personal characteristics, such as age and gender are less important for knowledge sharing between organizations, compared to knowledge sharing within organizations.

With regard to shared facilities/services, the results show that the frequency of using a lounge space and canteen/restaurant increases the frequency of sharing all four types of knowledge with people from other organizations. In addition, people using an event space more often share public non-codified and private knowledge more frequently with people from other organizations. It was known that common areas in single-tenant offices stimulate interactions between people (Kastelein, 2014). These results contribute to existing literature that using shared informal facilities and services in business centers could stimulate sharing non-codified knowledge between organizations as well, which is important for the innovative capabilities of organizations (Marouf, 2007). Although printing/copying areas were found to be important facilities for sharing private non-codified knowledge within organizations, no significant effects were found for knowledge sharing between organizations. Conversations at a

printing/copying facility might be too short and casual to share knowledge between organizations.

Table 26. Results for knowledge sharing (KS) between organizations

	Public non-codified KS	Public codified KS	Private non-codified KS	Private codified KS
	Coeff.	*Coeff.*	*Coeff.*	*Coeff.*
Personal characteristics				
Age				
Male		0.126		
Low education				
Hours working				0.004
Freelancer	0.234*			
Start-up enterprise				
Club membership	0.054		0.102*	0.054
Personality traits				
Traditional/ uncreative			-0.083**	
Trustworthy/ disciplined	0.0619			
Sympathetic/ warm				
Frequency of using an offered shared facility/service				
Lounge space	0.266**	0.285**	0.307**	0.339**
Event space	0.150*		0.138*	0.168**
Canteen/restaurant	0.088*	0.093*	0.116**	0.094**
Space for copying and printing		0.021		
Meeting space				
Project- or class room				
Consultancy services	1.098**		0.301	
Workspace characteristics				
Non-territorial		0.313		0.458**
Individual closed				
R2	0.283	0.201	0.269	0.312
Adjusted R2	0.264	0.186	0.253	0.312
SSR (Regression Sum of Squares)	280.592	290.514	358.369	315.853
MSE (Mean Square Error)	1.079	1.109	1.373	1.210

* and ** indicate that the coefficient is significant at the 0.05 and 0.01 level

Private and public codified knowledge is more frequently shared by people who use a non-territorial workspace that is used by all business center users. A previous study in single-tenant offices showed that interactions often occur in or near workstations (e.g., Rashid et al., 2009). Therefore, the use of workspaces in business centers is also very important for knowledge sharing with people from other organizations, especially with regard to codified knowledge. This shows the strength of

implementing non-territorial workspaces (mostly available in coworking offices) for creating a knowledge sharing community.

4.5.2 Discussion and conclusion

Business centers (especially coworking offices and incubators) are mostly branded as innovative work environments and also valued by tenants because of knowledge sharing opportunities with other organizations. However, it was still not clear which type of knowledge users mostly share within their organization and with other organizations and how this behavior is influenced by the physical work environment of business centers (controlling for personal characteristics). The aim of this study was therefore to analyze all hypothesized effects, based on the literature review, on sharing different types of knowledge within a business center. It provided new insights in particularly which types of knowledge shared are influenced in which way by the physical work environment of business centers. Another contribution to previous studies is that this study looks at knowledge sharing within as well as between organizations. This study was thus able to test existing theory on knowledge sharing within organizations in a different (shared) office context and simultaneously create new theory on how to support knowledge sharing between organizations in such offices.

Results showed that personal characteristics, the use of shared facilities and services and workspace characteristics influence sharing the four different types of knowledge within and between organizations. With regard to knowledge sharing within an organization, only a few differences between the different types of knowledge were found. Sharing knowledge within organizations was influenced by the frequency of using an individual closed workspace (negatively), meeting space (positively) and a restaurant/canteen (positively). Thus, similarly as in single-tenant offices, use of these informal spaces and working in a more open and flexible workspace is also important for knowledge sharing within organizations when working in a business center. In addition, people who are more willing to share knowledge, tend to use these spaces more frequently. Furthermore, the results showed that age and gender are important indicators for sharing all types of knowledge within organizations. HR managers of tenant organizations could stimulate older workers to share their valuable experiences and knowledge (Oye et al., 2013) with younger colleagues and vice versa, which could be beneficial for organizations.

Besides knowledge sharing within organizations, the study also analyzed knowledge sharing between organizations, at the scale of a business center which is its main contribution to existing literature. Research on knowledge sharing between

organizations at the scale of a business center is still scarce. The results showed that frequently using an informal meeting space (i.e., lounge space, event space and canteen) is important for sharing non-codified knowledge with people from other organizations. Especially, this type of knowledge is an important resource for organizations to increase their creativity and innovative capabilities (Marouf, 2007). Thus, owners or managers of business centers who aim at stimulating knowledge sharing between the tenant organizations in their buildings should offer more and attractive informal/social spaces and flexible/open work spaces. Managers of the tenant organizations should also motivate their employees to use informal/social spaces, meeting spaces and project spaces, to increase knowledge sharing within organizations and people from other organizations. For larger organizations, it is important to discuss with their facility managers to optimize the use of these meeting spaces, where smaller organizations need to discuss this matter with the building managers.

Public non-codified knowledge is more frequently shared by people who use consultancy services offered by the business center. No other relations were found with regard to services. This suggests that physical characteristics are more important for knowledge sharing with people from other organizations, than non-physical characteristics (i.e., offered services) of business centers. In addition, these services will probably be used and offered less often than spaces and facilities. Therefore, owners and managers of business centers should focus more on the physical aspects of the building to attract innovative tenants that focus on knowledge sharing. However, it is still important that business centers offer a high service level (i.e., coffee/tea facilities, catering, managed technology services and secretarial services) to differentiate themselves from other business centers and thus retain and attract more tenants.

Overall, the results provide new insights in the influence of the physical work environment of business centers on sharing types of knowledge within and between organizations. In addition, results show that knowledge sharing can also be explained by personal characteristics. These results are interesting for building managers to focus on and support tenants that want to share knowledge and to be innovative. For example, building managers could select innovative tenants, organize meetings between tenants that could learn from each other and organize networking events. They could also monitor the perceived support for knowledge sharing of tenants and adapt the physical work environment to these outcomes.

4.6 Conclusion

The aim of this chapter was to analyze social networking and knowledge sharing behavior in business centers and to analyze which physical- and non-physical characteristics influence this behavior. Results of the analyses showed that facilities/spaces for formal and informal meetings (i.e., restaurant/canteen, event space, lounge room, meeting space) influence networking and knowledge sharing behavior. In addition, flexible workspaces in an open work environment stimulate knowledge sharing with people from other organizations. Results of seemingly unrelated regression analysis showed that informal meeting spaces (i.e., lounge space, event space and canteen) are especially important for sharing non-codified knowledge with people from other organizations. This non-codified knowledge is highly important for the target groups of business centers (i.e., freelancers and SMEs), to be creative and innovative.

With regard to the use of offered services, only the use of consultancy services, managed technology and the use of coffee- and tea services were found to have significant influences. Thus, offered services by business center managers are not that important for stimulating social networking and knowledge sharing. Furthermore, besides characteristics of the business center, demographics (i.e., age, gender, education level) and work-related characteristics (i.e., number of hours or business club memberships) were also found to have a large effect on networking and knowledge sharing in business centers. Only two personality traits, namely 'traditional, uncreative' and 'extravert, enthusiastic', were found to have a significant effect on networking and knowledge sharing behavior. People who are more extravert, have a larger perceived business and social network and people who are more traditional/ uncreative, share less knowledge with people from other organizations. Specifically private non-codified knowledge, which is important for the innovation process, is shared less frequently by these personalities.

Overall, the analyses showed interesting results with regard to networking and knowledge sharing, which was up till now, still limited. These results are useful for owners and managers of business centers. They could stimulate knowledge sharing between and within organizations by offering more attractive informal/social spaces (i.e., lounge space, canteen/restaurant and event space) and flexible workspaces. Although results showed that the use of offered services are less important for networking and knowledge sharing, it is still important for owners/managers of business centers to offer a high service level (i.e., networking events, catering, the use of coffee and tea, business services, managed technology) to attract tenants.

5

Real-time networking and knowledge sharing behavior in business centers[3]

5.1 Introduction

Chapter 4 discussed the perceived networking and knowledge sharing behavior and which physical and non-physical business center characteristics influence this behavior. However, knowledge about whether and which type of knowledge is shared at which location in business centers, received limited attention in previous studies. In addition, previous research has focused exclusively on single-tenant offices and specifically on the frequency of face-to-face interactions or knowledge sharing within a single organization. Many property managers promote and brand their business center as an innovative work environment where different organizations share spaces, facilities and services with other organizations. Therefore, more empirical research on knowledge sharing behavior and location of face-to-face interactions in business centers is needed. This section addresses this research gap by looking at and the influence of the physical work environment on knowledge sharing behavior within and between different users of business centers, controlling for personal- and face-to-face interaction characteristics. In addition, the location choice for face-to-face interactions and factors influencing this choice were analyzed. The analyses are based on data collected using Experience Sampling Method (ESM) among 100 users of seven business centers in the Netherlands. The data are analyzed using a Mixed Multinomial Logit Model (MMNL).

The second section describes the data collection and methodology. Next, in the third section of this research, the influence of the physical work environment on whether and which type of knowledge is shared, is analyzed using a MMNL. The results showed that only one aspect of the physical work environment (i.e., office concept) if important for knowledge sharing, when we control for personal-, work related- and face-to-face interaction characteristics. In section 4, a MMNL was estimated whereby the location type choice in business centers for face-to-face interactions and knowledge sharing is analyzed. The final section gives a conclusion of this chapter.

5.2 Data collection and sample

5.2.1 Measures

The data collection consisted of a questionnaire and an ESM to collect detailed information about characteristics of face-to-face interactions of respondents, the person(s) they had a face-to-face interaction with (i.e., inter-organizational or intra-organizational interaction), personal- and work related characteristics and characteristics of the physical work environment.

Questionnaire

The questionnaire consisted of open- and closed questions about relevant personal-, work related characteristics (i.e., age, gender, income, education level, workdays, working hours, size organization, business sector position in the organization) and characteristics of their work environment. With regard to characteristics of the physical work environment, based on previous studies in single tenant offices, respondents were asked about the office concept, type of workspace and the use of their workspace. Van Meel (2000) distinguished office space into five different types of office concepts, namely a cellular office, group office, open-plan office, half open-plan office and a combi-office. Respondents were asked which type of office design reflects the floor space where they mostly work. Also, respondents were asked in which type of space they mostly work in the business center. They could choose from: alone in a closed space, together with others in a closed space, an open space without partitions or in an open space with partitions. The use of workspace was measured by asking respondents to indicate if they have a personal office (exclusively used by a single employee), shared office (used by employees on a rotating basis) or a non-territorial office (used by employees who do not own a workplace) (adapted from Van Meel, 2000).

Experience Sampling Method (ESM)

ESM is a useful method to analyze interpersonal interactions and to obtain a representative sample of individual's behavior (e.g., Uy et al., 2010; Fisher and To, 2012). Compared to traditional diary surveys, this method minimizes memory biases, because participants report their events when they occur. Dependent on the sampling frequency, however, this data collection method may be time-consuming and requires a lot of commitment of respondents. Therefore, it is important to limit the frequency and length of the reports, in order to increase the response rate (Uy et al., 2010).

There are three types of experience sampling methods, namely the signal contingent, interval contingent and event contingent method (Reis and Gable, 2000; Uy et al., 2010; Fisher and To, 2012). First, in the signal contingent method, participants are prompted (e.g., with smartphones devices) at random times within a fixed time period to report their experience or activity. For example, Dimotakis et al. (2011) collected data on measures of workplace interpersonal interactions of 60 employees for 10 workdays. Respondents were randomly signaled with PDAs within three two-hour time blocks (i.e., 9:30-11:30 am; 12:00-2:00 pm; 2:30-4:30 pm). They were asked to describe the interactions they had 30 minutes prior to the signal, by means of a short

questionnaire. Next, in the interval contingent method, participants report their events at predetermined intervals (e.g., every hour or daily). Binneweis et al. (2009) used this method in a study where they monitored 106 employees of public service organizations for one workweek. Participants were asked to fill in a questionnaire at three predetermined times a day, namely before they went to work, after work when they arrived at home, and before going to bed. Finally, in the event contingent method, participants need to report all events at the moment when they occur. These events are predetermined by the research project. For example, in the study by Côté and Moskowitz (1998) using this method, respondents were asked to report their interpersonal interactions for 20 days.

In this study, we use the signal contingent sampling method. Respondents are asked to report characteristics of face-to-face interactions that take place in the business center and that are more than just a greeting, 60 minutes prior to three random times a day for 10 workdays. At these random times, signals (i.e., smartphone and e-mail prompts) are send to respondents. In these prompts, respondents receive a link to the online questionnaire where they have to report their interactions.

In the ESM questionnaire, respondents are asked about the duration of the interaction and if the interaction is pre-planned, intentional unscheduled or coincidental (Brown, 2008; Koch and Steen, 2012; Appel-Meulenbroek, 2017). Respondents are also asked to indicate if the interaction is a social (informal) or business (formal) interaction. Furthermore, respondents are asked to indicate the main activity of their interaction, namely if the interaction was a discussion, a meeting, a chat/catch up, business lunch or dinner, a way to provide/receive information or advice, a network event, a brainstorm session or a workshop/presentation.

To analyze knowledge sharing behavior in business centers, respondents were asked whether they shared knowledge during the interaction. If they shared knowledge, they were subsequently asked, based on the literature on tacit and explicit knowledge, whether the knowledge is also available by an alternative source (i.e., documented (explicit) or another person(s)) (adapted from Appel-Meulenbroek, 2017). For each interaction, respondents were also asked to provide information about the person they had a face-to-face interaction with.

For each interaction, respondents are also asked to provide information about the person (i.e., alter) they had a face-to-face interaction with. First, they are asked if the interaction is with more than 3 people. If the respondents indicated that the interaction is with more than 3 people, the interaction are reported as a group interaction. For interactions with less than 3 people, respondents are asked if this

person is a colleague or a person from another organization. Furthermore, to measure the strength of ties respondents are asked about the frequency they interact with the person(s) they had an interaction with on a 5-point Likert scale ranging from (1) once a year or less to (5) multiple times a week. Besides the frequency of interactions, also the duration and closeness of the relation are important aspects of tie strength. Respondents are asked about the closeness of their relation on a 5-point Likert scale, ranging from (1) not close at all, to (5) very close. They are also asked about the duration of the relationship with this person by indicating how long they have known each other (i.e., not (1), less than 1 year (2), 1 till 2 years (3), 2 till 5 years (4), 5 years or longer (5)). To obtain a measure of tie strength, the sum score of the frequency of interaction, duration and closeness of the relationship is determined. The value of the Cronbach Alpha is 0.674, which means that the internal consistency of the items is acceptable.

Last, respondents are asked to indicate the location type of the face-to-face interaction in the business center. They can choose between types of spaces/facilities that are usually offered in a business center, determined in the study by Weijs-Perrée et al. (2016). The types include workspaces, café/restaurant, formal meeting spaces, informal/social meeting spaces, project/creative spaces, event spaces, space for copying/printing, reception, kitchen, restaurant/café, coffee corner/pantry and lounge space.

5.2.2   Sample and procedure

Data were collected between May and June 2017 among users of seven business centers in the Netherlands. These were selected based on the sample of business centers used in a previous descriptive study (Weijs-Perrée et al., 2016). Table 27 shows some descriptive statistics of these seven business centers. As can be seen, these business centers are serviced offices, coworking offices, or a combination of an incubator and coworking office. They all have the objective to stimulate knowledge sharing and to create a community. Regular business centers were not taken into account in this study, because this concept only focuses on offering office space without any additional shared services/facilities. Thus, the sample represents only business centers with knowledge sharing as a unique selling point. The business centers offer office space for self-employed people, independent workers, SMEs, start-up enterprises and large companies. All business centers offer networking events as a service to their tenants. In addition, four business centers also offer workshops/lectures. The gross floor area (GFA) of the business centers varies from 4.500 m^2 to 55.000 m^2.

Furthermore, the number of tenants per business centers varies from 6 tenants to 180 tenants. The managers of these business centers that were willing to participate in this research sent an e-mail to all tenants of the business centers with the request to distribute the questionnaire among all their employees. In addition, to increase the response rate, the business centers were also personally visited. Overall, 179 users filled in the questionnaire and of these users, 100 users responded through the prompts to the questionnaire about their interactions in the business center (see Table 28). Only data of these 100 business center users was used in the analyses.

As can be seen in Table 29, the final sample consists of a slightly higher share of males (61%). The average age of the users is 39 years. Most respondents in the dataset have a moderate or high education level (i.e., undergraduate or postgraduate) (81%). The dataset includes 22% of self-employed workers, 27% works for a company with 2-10 employees, 25% works for a company with 11-50 employees and 26% works for a larger company with more than 50 employees. The average number of hours that business center users work at the business center, during a normal workweek, is 32 hours. Most respondents work in the business service sector (37%), building sector (20%) or in the information & communication technology (ICT)/media sector (19%).

A total of 4074 prompts with a link to the online questionnaire, were sent to 179 business center users. Of these 4074 questionnaires on face-to-face interaction, only 1592 were completed (39%) by 122 users. However, 22 users indicated in the questionnaire that they were not at the business center (489 times) or did not have a face-to-face interaction during the hour before they received the prompt (579 times). In this study, only the 100 respondents that reported a face-to-face interaction were included in the analyses. The 100 respondents reported a total of 658 interactions during 10 workdays. The number of reported interactions by the respondents per day is shown in Figure 7 and the distribution of the total number of reported face-to-face interactions per respondent is shown in Figure 8.

Table 27. Characteristics of the seven business centers

Business center	1	2	3	4	5	6	7
# Respondents	20	22	22	7	17	3	9
Size business center							
GFA (m^2)	24000	5000	4500	55000	6000	7735	10000
# tenants	47	25	39	180	6	29	27
Objectives							
To offer shared facilities and services	X	X	X	X	X	X	X
Creating a working community	X	X	X	X	X	X	X
To support and facilitate start-up enterprises	X	X	X		X	X	X
Stimulate knowledge sharing	X	X	X	X	X	X	X
Target group							
Self-employed people	X	X	X	X	X	X	X
Independent workers	X		X	X		X	X
SMEs	X	X	X	X	X	X	X
Start-up enterprises	X	X	X	X		X	X
Large companies	X	X	X	X	X	X	X
Offered services/facilities							
Networking events	X	X	X	X	X	X	X
Workshops and lectures	X	X	X		X		
(Shared) spaces/facilities							
Shared coffee corner	X	X	X		X	X	X
Informal/social space	X	X	X	X	X	X	X
Canteen/café/ restaurant	X	X	X	X	X		X

Statistics about the characteristics of the face-to-face interactions are shown in Table 30. Most interactions were work-related (61%). The duration of these interactions was on average 30 minutes. Most interactions in the sample were interactions with the main activity discuss/debate (41%) or to catch up/chat (24%). The main locations where the interactions took place were around people's own workplace (43%), in a meeting room (14%), at the workplace of other(s) (13%) or at a café/restaurant (10%). Previous studies also showed that most interactions occur near workstations (e.g., Rashid et al.,

2006). Of all interactions, 27% were group interactions with more than 3 people and 26% were interactions with at least one person from another organization. In total, 362 unique contacts were reported for the 658 interactions. These contacts were mostly people working for the same organization (61%) and in the same building (83%) as the respondent. With regard to knowledge sharing behavior, during many interactions (63%) knowledge was shared.

Table 28. Overview of respondents per business center

Business centers	First part		Second part (i.e., ESM)	
	(N)	(%)	(N)	(%)
Building 1	48	27	20	20
Building 2	34	19	22	22
Building 3	36	20	22	22
Building 4	18	10	7	7
Building 5	20	11	17	17
Building 6	13	8	3	3
Building 7	10	6	9	9
Total	179	100	100	100
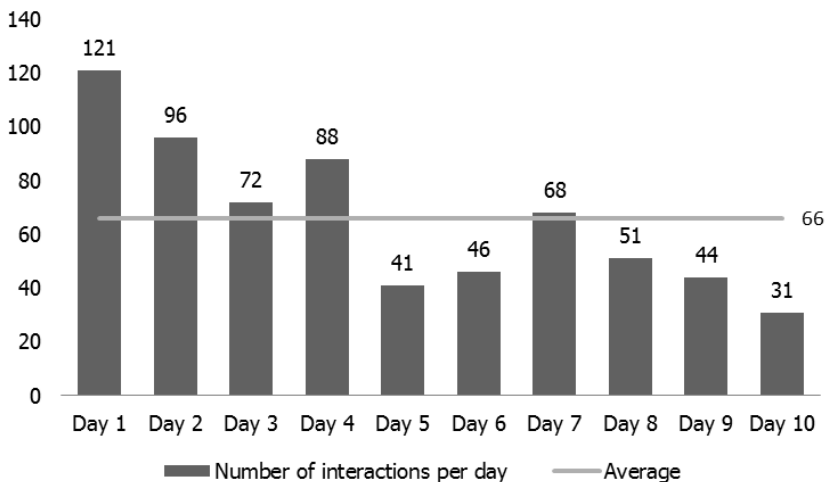
Figure 7. Reported face-to-face interactions per day
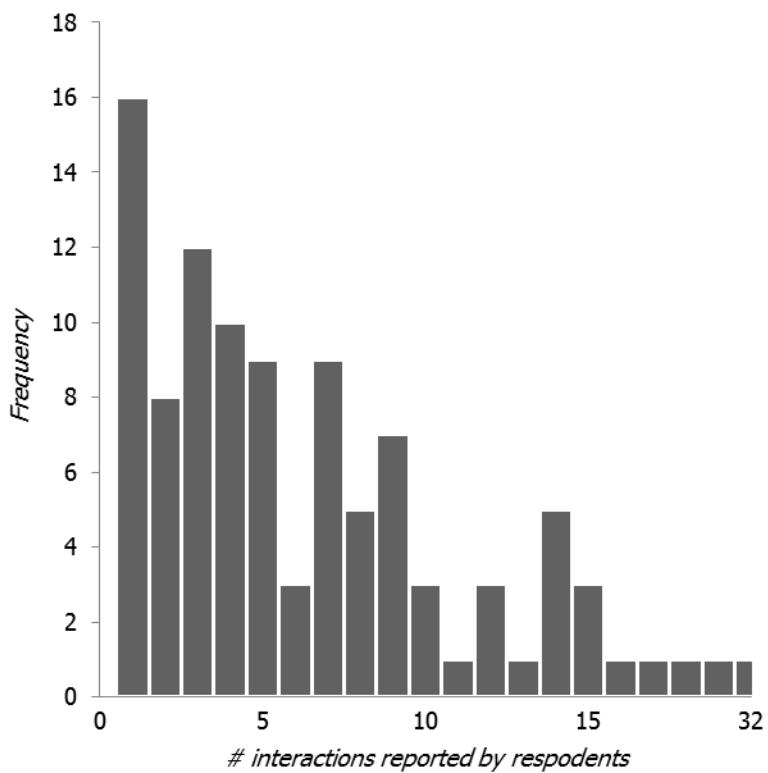
Figure 8. Distribution of reported face-to-face interactions

Table 29. Sample characteristics (N=100)

	(%)	Mean
Personal- and work related characteristics		
Age		38.71
Gender		
Male	61	
Female	39	
Income		
Low income (< € 30.000)	21	
Moderate income (€ 30.000 - € 50.000)	33	
High income (> € 50.000)	20	
(missing)	26	
Education level		
Low education level (Secondary or vocational education)	19	
Moderate education level (Undergraduate)	47	
High education level (Postgraduate)	34	
Organization size		
Self-employed worker, freelancer or entrepreneur	22	
Employee of company (2-10 employees)	27	
Employee of company (11-50 employees)	25	
Employee of company (more than 50 employees)	26	
# Hours working in the business center (on average in a week)		31.74
Characteristics of the physical work environment		
Office concept		
Cellular office	5	
Group office	23	
Open-plan office	48	
Combi-office	24	
Workspace type		
Individual workspace (alone in a closed space)	7	
Together with others in a closed space	30	
An open space without partitions	50	
An open space with partitions	13	
Workspace use		
A personal workspace	71	
Workspace on rotation basis	11	
Flexible used workspace	18	

Table 30. Face-to-face interaction characteristics (N=658)

	(N)	(%)	Inter-organizational interactions (n=173) (%)	Intra-organizational interactions (n=483) (%)
Type of interaction				
Work related interaction	402	61	55	63
Social interaction	182	28	31	27
Both	74	11	14	10
Preplanned or unplanned interaction				
Consciously, but without a preplanned appointment	271	41	35	44
Preplanned interaction	218	33	27	35
Coincidentally encountered	169	26	38	21
Main activity interaction				
Discuss/debate	266	41	34	43
Catch up/chat	159	24	32	21
Other activity	80	13	14	11
Giving or receiving information/advice	62	9	9	10
Formal meeting	54	8	6	9
Business lunch/diner	37	6	5	6
Group interaction (with >3 people)				
No	483	73		
Yes	175	27		
Interaction with minimal 1 person of another organization				
No	483	74		
Yes	173	26		
Interaction with minimal 1 strong tie				
No	242	37		
Yes	416	63		

With regard to the location, Figure 9 shows the distribution of the number of face-to-face interactions across location types. As can be seen, most interactions take place at or around people's own workspace, in a formal meeting space, around the workspace of other(s) or at a café/restaurant/canteen within the building. Other locations that were reported by the respondents were a laboratory, storage room, space for sports/fitness and a telephone space. This is in line with the finding in previous studies in single tenant offices that most interactions take place near or at people's workspaces (e.g., Rashid et al., 2009). However, previous studies did not look into the location choice for different types of interaction.
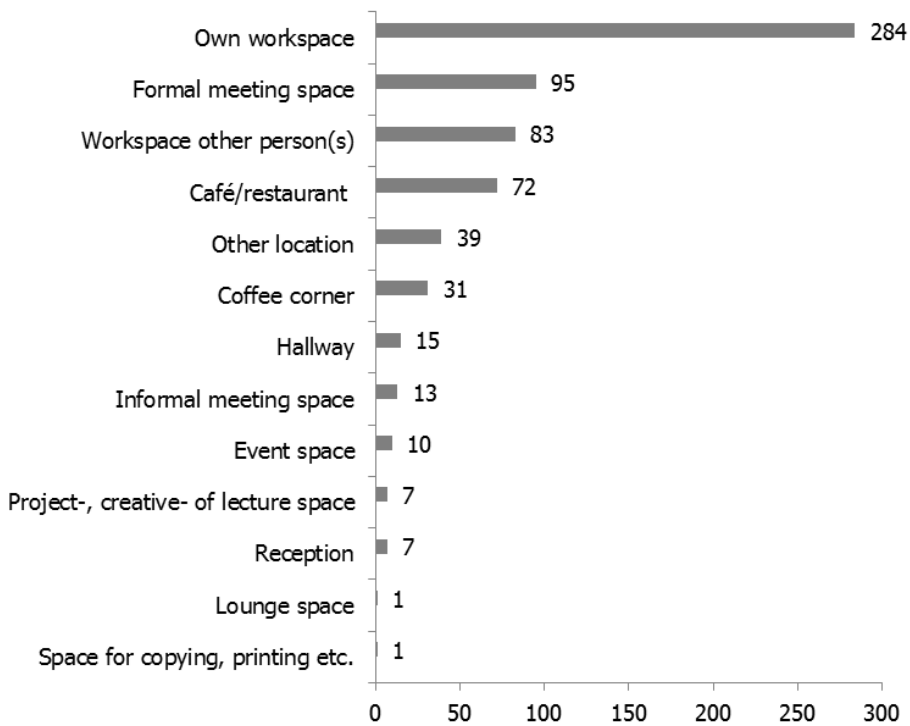
Figure 9. Distribution number of face-to-face interactions per location type

5.3 Factors influencing knowledge sharing types in business centers

Through the easy access to information and communication through electronic tools (Heerwagen et al., 2010), the workplace has changed over the past decades. People increasingly work at a remote location, such as at a home or at 'hot-spots' in public venues (e.g., café, restaurant or hotel) (Cole et al., 2014). However, the workplace is still one of the main locations where people spend most of their time (Génois et al., 2015), and is therefore an important location for interacting and knowledge sharing. It is recognized that especially face-to-face interactions are important for sharing interests, rich information exchange, socializing, productivity and knowledge sharing (Suckley and Dobson, 2014; Sailer et al., 2016).

The awareness of the importance of the work environment for knowledge sharing increased, because knowledge is one of the most important resources of an organization (Ipe, 2003). Especially, sharing tacit knowledge is important for increasing the innovation process of organizations (Marouf, 2007). Therefore, organizations are increasingly searching for work environments that stimulate knowledge sharing (Kastelein, 2014).

The opportunity for networking and knowledge sharing is also promoted as one of the main advantages of renting a space in business centers (Bøllingtoft, 2012; Ketting, 2014). A business center is an office building, were office space, facilities and services are offered to and shared by multiple organizations (Weijs-Perrée et al., 2016). Organizations, especially freelancers and SMEs, are increasingly seeking accommodation in business centers due to shared facilities/services, flexible lease of office space and facilities and an expectation of a better balance between private and work life and the opportunity to network and collaborate with other users (e.g., Barber et al., 2005).

Recently, there has been a growing interest in the relationship between the physical work environment and knowledge sharing within a larger organization. Previous studies showed that the design and layout of the work environment in offices could influence patterns of interactions and knowledge sharing (e.g., Rachid et al., 2006; Appel-Meulenbroek, 2017). Open work environments, for example, stimulate face-to-face interactions (Becker and Sims, 2001; Blakstad et al., 2009). Moreover, shared informal facilities or spaces, such as coffee areas, lounge spaces or meeting rooms, could increase the number of informal interactions and knowledge sharing between employees (Staplehurst and Ragsdell, 2010; Kastelein, 2014; Appel-Meulenbroek, 2017).

Previous work has, however, focused exclusively on networking behavior among tenants of incubators (i.e., business center type that focuses on (high-tech) start-up enterprises) (e.g., Bøllingtoft and Ulhøi, 2005; Cooper et al., 2012) or on the frequency of face-to-face interactions or overall knowledge sharing behavior within a single (large) organization (e.g., Blakstad et al., 2009; Sailer et al., 2016). Research into whether and which type of knowledge is shared between organizations in business centers is still limited. Many property managers promote and brand their business center as an innovative work environment where organizations share spaces, facilities/services and knowledge with each other. More empirical research on the actual sharing of different types of knowledge in business centers is needed to support this claim. Therefore, the aim of this section is to analyze the choice whether and which type of knowledge is shared within and between organizations in business centers and how this behavior is influenced by face-to-face interaction characteristics, personal characteristics and characteristics of the physical work environment.

5.3.1 Methodology

For the analysis, knowledge sharing behavior in this study was categorized as 4 types of behaviors (i.e., choices/alternatives), namely:

- Knowledge 1: not sharing knowledge
- Knowledge 2: knowledge shared, which is also available in documented form
- Knowledge 3: knowledge shared, which is also available through other people
- Knowledge 4: knowledge shared, which is only available through the person(s) who shared the knowledge during the interaction (tacit knowledge)

The respondents in the sample chose in 37% of the interactions, not to share knowledge at all, 8% to share knowledge that is also available in documents (e.g., website or a book), 11% to share knowledge that is also available through other people that were not present during the interaction and 44% to share knowledge that is only available from the person(s) who shared knowledge during the interaction (i.e., tacit knowledge).

Bivariate analyses revealed several significant relationships between personal-, work related-, work environment- and interaction characteristics and knowledge sharing behavior in business centers (see Table 31, 32, 33). As expected, bivariate analyses showed that younger workers share overall less knowledge than older people. Working for a larger organization and working more hours per week increases the propensity that documented knowledge is shared in a business center, compared to the other

types of knowledge sharing. With regard to the physical work environment of the interaction, an open work environment with partitions increases the propensity that (tacit) knowledge is shared during an interaction compared to a closed space or an open space without partitions. In addition, a meeting room was found to be an important facility for sharing tacit knowledge. A café/restaurant is a facility where the least knowledge is shared.

Table 31. The influence of personal- and work related characteristics on knowledge sharing behavior

	Knowledge sharing behavior				
	1	*2*	*3*	*4*	
	Mean				*F*
Age	36.75	39.12	40.17	39.49	(F= 3.16; p=0.024*)
# Total workhours per week	32.01	37.21	35.77	32.13	(F= 5.82; p=0.001**)
	# Interactions				*Pearson Chi-Square*
Gender					
Male (dummy)					(χ2=10.94; p=0.012*)
Yes	94	11	16	111	
No	151	41	53	181	
Education level					
Low education level (dummy)					(χ2=18.59; p=0.00**)
Yes	42	23	14	64	
No	203	29	55	228	
User group					
Self-employed worker (dummy)					(χ2=19.84; p=0.00**)
Yes	64	1	20	52	
No	181	51	49	240	
Company (2-10 employees) (dummy)					(χ2=8.28; p=0.041*)
Yes	51	17	12	84	
No	194	35	57	208	
Company (>50 employees) (dummy)					(χ2=14.48; p=0.001**)
Yes	62	27	22	93	
No	183	25	47	199	

* and ** indicate that the coefficient is significant at the 0.05 and 0.01 level

Table 32. The influence of the physical work environment on knowledge sharing behavior

		Knowledge sharing behavior				
		1	2	3	4	
		# Interactions				Pearson Chi-Square
Office concept						
Cellular office (dummy)						(χ2=11.67; p=0.009**)
	Yes	18	2	0	7	
	No	227	50	69	285	
Workspace type						
An open space with partitions (dummy)						(χ2=14.798; p=0.002**)
	Yes	24	8	18	31	
	No	221	44	51	261	

* and ** indicate that the coefficient is significant at the 0.05 and 0.01 level

Table 33. The influence of interaction characteristics on knowledge sharing behavior

		Knowledge sharing behavior				
		1	2	3	4	
		Mean				F
Duration (in minutes)		19.35	59.50	33.20	34.27	(F= 13.99; p=0.00**)
		# Interactions				Pearson Chi-Square
Type of interaction						
Social interaction (dummy)						(χ2=204.72; p=0.00**)
	Yes	147	2	7	26	
	No	98	50	62	266	
Interaction (<1 person other organization) (dummy)						(χ2=11.58; p=0.009**)
	Yes	75	4	19	77	
	No	170	48	50	215	
Group interaction (> 3 people) (dummy)						(χ2=13.74; p=0.003**)
	Yes	70	23	19	61	
	No	175	29	50	231	

Table 33. Continued

	Knowledge sharing behavior				
	1	2	3	4	
	# Interactions				Pearson Chi-Square
Preplanned or unplanned					
Preplanned interaction (dummy)					(χ2=30.21; p=0.00**)
Yes	50	25	29	114	
No	195	27	40	178	
Coincidentally encountered (dummy)					(χ2=42.52; p=0.00**)
Yes	97	4	13	55	
No	148	48	56	237	
Type of main activity of the interaction					
Discuss/debate (dummy)					(χ2=42.02; p=0.00**)
Yes	60	23	34	149	
No	185	29	35	143	
Meeting (dummy)					(χ2=21.73; p=0.00**)
Yes	6	5	4	39	
No	239	47	65	253	
Catch up/chat (dummy)					(χ2=71.54; p=0.00**)
Yes	104	7	11	37	
No	141	45	58	255	
Giving or receiving advice (dummy)					(χ2=14.86; p=0.002**)
Yes	10	4	10	38	
No	235	48	59	254	
Location of the interaction					
Meeting room					(χ2=8.07; p=0.045*)
Yes	25	11	8	51	
No	220	41	61	241	
Café/restaurant					(χ2=38.24; p=0.00**)
Yes	50	1	7	14	
No	195	51	62	278	

* and ** indicate that the coefficient is significant at the 0.05 and 0.01 level

To analyze all hypothesized effects of the physical work environment on knowledge sharing behavior, controlling for personal- and interaction characteristics, simultaneously in a multivariate framework, a Mixed Multinomial Logit Model (MMNL) was used. This state-of-the-art discrete choice model allows analyzing panel data and error components (McFadden and Train, 2000; Hensher and Greene, 2003). The main

advantage of the MMNL model is that it can capture unobserved heterogeneity between individuals by estimating a distribution for each (utility) parameter. The model provides much flexibility, because the random components of the utility specification may be assumed to have any distribution (Train, 2003).

The unit of analysis for the model estimated is a face-to-face interaction and the dependent variable is the choice for the type of knowledge shared during the interaction (where not sharing knowledge is taken as base alternative). A random parameter was estimated for the utility constant term for each alternative of knowledge sharing during a face-to-face interaction to capture possible heterogeneity in base preferences. The distribution of each random parameter was defined by a normal distribution. The random parameters may be correlated due to patterns of similarities between knowledge types. To estimate the correlations simultaneously, the Cholesky decomposition was used (see Hensher and Greene, 2003). Independent variables related to the person, work environment and nature of the interaction were included as interactions with all the types of knowledge shared (e.g., male * Knowledge 2). The dummy variables that turned out to be significant in the bivariate analyze were included as interaction terms. To reduce degrees of freedom, the coefficients of the interaction terms are estimated as non-random parameters. First, multiple MMNL models were estimated with several interaction variables. All possible combinations of interaction variables were added to the MMNL models one by one and were removed when they turned out not to be significant. This resulted in a final model with only significant interaction variables. To estimate the parameters of the final model, 1000 Halton draws were used. Halton draws is a more efficient way to probe a distribution compared to just random draws (Bhat, 2001). Also, a model was estimated with error components between the choice alternatives. However, the model using the Cholesky matrix offered a better model fit (Log likelihood value of -596.6 versus a value of -605.8) and was therefore selected.

5.3.2   Results

Table 34 shows the parameter estimates of the final model and their significance for explaining the choice which type of knowledge was shared. Interaction effects between the knowledge sharing types and type of interaction, pre-planned interaction, inter-organizational interaction, office concept, different interaction activities, gender and organization size appear to be significant.

The value of the (adjusted) Rho square of the final model is 0.34, which indicates that the model performs well. The standard deviations of the error terms are

significant indicating that heterogeneity exists across individuals in terms of base preferences for knowledge sharing behavior types. Furthermore, the correlation matrix in Table 35 shows high correlations between the random parameters (i.e., Knowledge 2 and Knowledge 4). With regard to the random parameters, significant standard deviations were found for all types of knowledge sharing. This suggests that employees differ in their propensity to share specific types of knowledge.
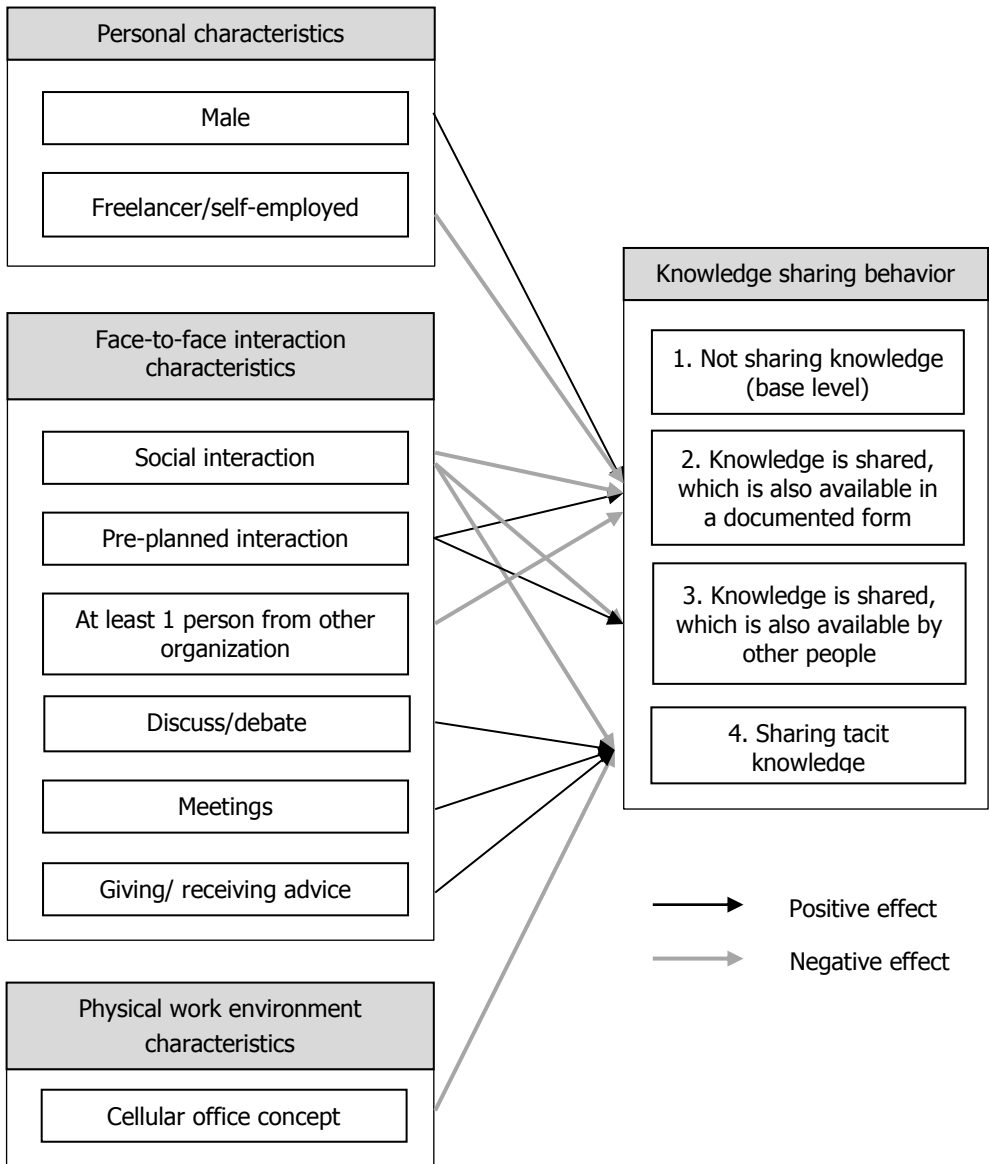
Figure 10. Visualization of MMNL model knowledge sharing behavior

Table 34 and Figure 10 also present the results related to the effects of personal-, work related-, work environment- and face-to-face interaction characteristics on the choice to share one of the four knowledge types. Not surprisingly, the parameters for the interaction effects with regard to the type of interaction show that during social interactions, knowledge is shared less often than during business interactions. With regard to pre-planned interactions, results show that the propensity is higher during a pre-planned interaction that knowledge is shared, which is also available in documented form (i.e., Knowledge 2) and by the other persons(s) (i.e., Knowledge 3) than during unplanned interactions. If the interaction is with minimally one person from another organization, the propensity that explicit knowledge is shared is lower than during an intra-organizational interaction. It is also recognized that knowledge sharing between organizations is more complex because of more substantial boundaries between different organizational cultures and processes (Easterby-Smith et al., 2008).

Furthermore, the positive interaction effects between the activities and knowledge sharing type suggest that during a discussion/debate, meeting and when receiving or giving information, the propensity that tacit knowledge (i.e., Knowledge 4) is shared is higher than during other activities. The parameter for the interaction effect with regard to a cellular office shows that the propensity that people, who work in a cellular office, share tacit knowledge is lower than for people who work in another office concept (i.e., group office, combi-office and open-plan office). Previous studies in single-tenant offices also showed that an open office concept, compared to a cellular office, stimulates informal interactions, collaboration and knowledge sharing behavior between workers (Blakstad et al., 2009).

The negative parameter for male (p < 0.10) suggests that men more often share knowledge that is also available in a documented form (i.e., explicit knowledge) than women, compared to the other types of knowledge. Previous research showed that men, in general, discuss more often their work during interactions and therefore more often share knowledge than women (Zengyu Huang et al., 2013). Finally, the negative interaction effect between the freelancers/self-employed workers and Knowledge sharing type 2 suggests that this organization type shares knowledge that is also available in a documented form less often. The results of the MMNL model showed no significant effects of age, education level, job position and the number of hours working at the business center.

Table 34. Mixed multinomial logit model results (N=658 interactions/choices of 100 respondents)

Random parameters	Parameter (t-statistic)		
Knowledge 1 (base level)	0		
Knowledge 2	-1.277*** (-2.59)		
Knowledge 3	-0.834*** (-2.43)		
Knowledge 4	0.458 (1.60)		
Interaction variables (non-random parameters)	*Knowledge 2*	*Knowledge 3*	*Knowledge 4*
Male (dummy)	0.915* (1.86)		
Freelancer/self-employed (dummy)	-2.569** (-2.32)		
Social interaction (dummy)	-3.895***(-4.93)	-2.980*** (-6.00)	-2.463*** (-6.76)
Pre-planned interaction (dummy)	0.791**(2.21)	0.588*(1.86)	
Interaction with at least one person of another organization (dummy)	-1.208* (-2.09)		
Cellular office concept (dummy)			-1.829*(-1.94)
Discuss/debate (dummy)			1.095***(3.81)
Giving or receiving information/ advice (dummy)			1.235***(3.10)
Meeting (dummy)			1.669***(3.82)
Standard deviation	1.120*** (2.88)	1.176***(2.71)	1.183***(5.71)
Parameters	21		
Log Likelihood function (LL(β))	-596.64		
Log Likelihood function null model (LL(0))	-912.18		
ρ2	0.346		
ρ2 adjusted	0.339		

*Significant at 0.1 level, **Significant at 0.05 level, *** Significant at 0.01 level

Table 35. Correlation matrix random parameters

	Knowledge 2	Knowledge 3	Knowledge 4
Knowledge 2	1.000	-0.425	-0.621
Knowledge 3	-0.425	1.000	0.246
Knowledge 4	-0.621	0.246	1.000

5.3.3 Discussion and conclusion

The opportunity for networking and knowledge sharing with other organizations is one of the main advantages for business center users (Ketting, 2014). In addition, many business centers are promoted and branded as innovative work environments with shared workspaces and facilities. However, research on the influence of the physical work environment on actual knowledge sharing behavior, through inter-organizational face-to-face interactions in business centers is still limited. More insight into users' knowledge sharing behavior could help owners of business centers to develop more interactive work environments to attract and retain more tenants. Therefore, the aim of this study was to analyze the influence of the physical work environment on business centers users' propensity to share different types of knowledge, controlling for several personal- and interaction characteristics. In addition, the difference between inter-organizational interactions and intra-organizational interactions, with regard to the type of knowledge that is shared, was analyzed.

The MMNL model-based analysis showed that only one aspect of the physical work environment (i.e., office concept) has a significant effect, when we control for personal- and interaction characteristics. In specific, we found that a cellular office concept has a negative effect on sharing tacit knowledge. Thus, to stimulate more tacit knowledge sharing in business centers, this finding suggests that cellular offices should preferably not be used in business centers. However, a previous study showed that a cellular office is one of the best-rated office types in terms of job satisfaction (Bodin et al., 2008). It is also recognized by several previous studies on single-tenant offices that a physical work environment with a good mix between open and closed workspaces based on users' needs and preferences increases their productivity, creativity and workspace satisfaction (e.g., Lee, 2016; Palvalin et al., 2017; Gerdenitsch et al., 2017). However, the limited amount of significant effects of the physical work environment show that property managers of business centers need to make a shift of their emphasis from the building to the people (Mitchell-Ketzes, 2003). They need to make interventions based on the type of business center users and their specific needs and preferences. Involving business center users in decisions about the work environment could help to develop offices that meet the specific needs of users (Gerdenitsch et al., 2017).

The analyses also revealed interesting differences between inter-organizational interactions and intra-organizational interactions with regard to the type of knowledge that was shared. The results showed that inter-organizational interacting has a negative effect on sharing knowledge that is also available in documented form. Thus, during

inter-organizational interactions mostly no knowledge, knowledge that is also available through other people or tacit knowledge is shared. Especially sharing tacit knowledge is important for organizations to increase their creativity and innovation processes (Nonaka et al., 2000). This finding shows the importance of shared spaces/facilities and services, which are also one of the main unique selling points of many business centers, to facilitate inter-organizational interactions whereby (tacit) knowledge is shared.

The results showed, particularly, that interaction characteristics have significant effects on the type of knowledge shared in business centers. These results add to previous studies in single tenant offices that mainly focus on the frequency of interactions, that the characteristics (i.e., content) of face-to-face interactions are also important indicators for knowledge sharing behavior. The results suggest that during pre-planned interactions, the propensity that Knowledge 2 and 3 is shared is higher than during unplanned interactions, compared to the propensity that no knowledge or tacit knowledge is shared. In addition, Ngah and Jusoff (2009) suggested that sharing tacit knowledge (Knowledge 4) is most effective through spontaneous and unplanned (informal) face-to-face interactions. The findings also suggest that mostly no knowledge is shared during social interactions. On the other hand, it is recognized in previous research that social interactions could lead to more trust and a stronger connection between people that eventually could lead to a higher willingness to share knowledge (Van Wijk et al., 2008). Thus, accommodating social interactions is also still important for organizations to share knowledge. Organizations should therefore stimulate their employees to meet others by organizing more events, such as workshops, networking events or brainstorm sessions whereby colleagues and organizations can discuss/debate on interesting and give each other useful feedback. These activities were also found to be very important for sharing tacit knowledge, which eventually adds more value to innovation processes (Marouf, 2007). Property managers of business centers that focus on knowledge sharing should therefore develop spaces that facilitate these interaction activities and unplanned interactions to create a more attractive and interactive work environment.

5.4 Location type choice for face-to-face interactions in business centers

More and more organizations are aware of the importance of offering an attractive and supportive work environment to attract and retain talent (Earle, 2003) and there is a growing interest in people's behavior in different workplace settings (e.g., Vischer, 2008), specifically with regard to workers' (social) networking behavior (e.g., Toker and Gray, 2008; Sailer et al., 2016). Communication and information flows have become increasingly important for organizations (Heerwagen et al., 2010). Despite the advancements in communication technology, in person face-to-face interactions at work remain highly important, because they can help to facilitate socialization and learning which increase productivity and job satisfaction and to build trust among workers that eventually leads to better working relationships (e.g., Zahn, 1991; Storper and Vanables, 2004; Stryker and Santoro, 2012; Brown et al., 2014; Sailer et al., 2016). Subsequently, this can help to increase the sharing of interpersonal information or knowledge, innovative capabilities of organizations and organizational success (e.g., Nardi and Whittaker, 2002; Toker and Gray, 2008; Wolfeld, 2010).

Networking opportunities with other organizations is one of the main advantages according to occupants of business centers (Bøllingtoft, 2012; Ketting, 2014). Over the past decades, the number of business centers (e.g., incubators, serviced offices and coworking offices) increased globally (e.g., Hackett and Dilts, 2004; Waber et al., 2014; Deskmag, 2015). Business centers are characterized by their shared work environment, facilities and services by multiple organizations (Calder and Courtney, 1992; Weijs-Perrée et al., 2016). Therefore, many of these offices are branded as interactive work environments (e.g., Van Meel and Brinkø, 2014). However, it is still not clear whether and where in the buildings these organizations interact and how this behavior is facilitated through the physical work environment of business centers.

Previous workplace research in single-tenant offices showed that people's workspace (i.e., desk/workstation), shared workplaces and meeting spaces are important locations for face-to-face interactions among workers (e.g., Peponis et al., 2007; Hua et al., 2011; Kabo et al., 2013; Kastelein, 2014). However, previous studies focused mainly on face-to-face interactions within large organizations in single-tenant offices and not on face-to-face interactions between smaller organizations (mostly SMEs or freelancers/self-employed workers) in the context of business centers. Especially for these smaller organizations, networking with other organizations is important to grow

and increase their performance (e.g., Park et al., 2010). Furthermore, previous studies also mainly focused on users' perceptions regarding interactive behavior or on the frequency of interacting (e.g., Bøllingtoft and Ulhøi, 2005; Peponis et al., 2007; Cooper et al., 2012; Sailer et al., 2016) and not on characteristics of face-to-face interaction behavior (e.g., type or activities etc.) or by using real-time data to minimize memory effects. And last, many business centers offer more flexible workplaces and shared facilities, which provide more freedom in where to interact with others than in the fixed layout of many single-tenant offices from most previous studies. So, to get more insight employee's inter- and intra-organizational interaction behavior, where this behavior takes place in business centers and how to steer on this behavior with the physical work environment, further research is needed. Therefore, the main aim of this study is to analyze the location type choice for face-to-face interactions of business center users, controlling for interaction-, personal- and physical work environment characteristics.

5.4.1 Methodology

A MMNL model is used to analyze the expected effects on the location type choice. The MMNL method is a state-of-the art discrete choice model for analyzing panel data (McFadden and Train, 2000; Hensher and Greene, 2003). The MMNL allows for heterogeneity in choice behavior by offering the possibility to use random parameters in the utility functions of, in this case, location type alternatives for face-to-face interactions in business centers. The model provides much flexibility, because the random components of the utility specification may be assumed to have any distribution (Train, 2003).

A face-to-face interaction is the unit of analysis and the dependent variable is the choice of the location of the interaction in the estimated model. A random parameter is estimated for the utility constant term for each location alternative to capture possible heterogeneity in base preferences for locations. In addition, preferences for location alternatives may be correlated due to similarities between location type choices. To allow for these correlations we estimate the correlations between error terms of utilities of alternatives simultaneously using the method of Cholesky decomposition (Hensher and Greene, 2003). Independent variables (i.e., interaction characteristics, demographics, work-related and work-environment characteristics) are included as interactions with all the location type alternatives (e.g., social interaction * Location type 2). To reduce degrees of freedom, the coefficients of the interaction terms are estimated as non-random parameters. Furthermore, a stepwise model selection is performed by adding interaction terms for one independent

variable at a time. Interaction variables that are insignificant are subsequently removed. This process is repeated until a model is estimated with only significant effects. The parameters of the final model were estimated by using 1000 Halton draws, which is a more efficient way to probe a distribution compared to just random draws (Bhat, 2003).

5.4.2 Results

For the model-based analysis, the location alternatives for face-to-face interactions are categorized into five location types. These location types are reported most often by respondents and are also identified as important locations for face-to-face interactions in single-tenant offices (e.g., Boutellier et al., 2008; Hua et al., 2011; Kastelein, 2014; Staplehurst and Ragsdell, 2010):

- Location 1: Workspace (own or other person(s))
- Location 2: Formal meeting space
- Location 3: Coffee corner/pantry (i.e., a space with a coffee machine and/or small kitchen)
- Location 4: Café/restaurant/canteen (i.e., a (casual) place for eating/drinks)
- Location 5: Other locations (i.e., lounge space, reception, space for copying/printing, project space, event space, informal meeting space, and hallway)

Of all interactions, 56% took place at the workspace, 14% at a formal meeting space, 11% at a café/restaurant/canteen, 5% at the coffee corner/pantry and 14% at other locations (i.e., informal spaces, such as lounge space, hallway or event space etc.).

Bivariate analyses revealed several significant relationships between personal-, work related-, work environment- and interaction characteristics and location choice of face-to-face interactions in business centers (see Table 36, 37 and 38). As can be seen, younger users are more likely to use the coffee corner for face-to-face interactions compared to older users, who are more likely to use other locations (e.g., lounge space, reception, space for copying/printing, project space, event space, informal meeting space, and hallway) for their interactions. Furthermore, Table 36 showed that people working for a larger company are more likely to use a meeting space than self-employed workers.

Table 36. The influence of personal- and work related characteristics on the location type choice

	Location type choice					
	1	2	3	4	5	
	Mean					F
Age	38.47	38.34	35.26	36.06	41.87	(F= 3.46; p=0.008**)
# Total workhours per week	33.59	31.94	34.68	32.93	30.31	(F= 2.23; p=0.065)
	# Interactions					Pearson Chi-Square
Gender						
Male (dummy)						(χ2=2.35; p=0.671)
Yes	233	63	20	44	66	
No	134	32	11	28	27	
Education level						
Low education level (dummy)						(χ2=10.00; p=0.040*)
Yes	92	15	4	19	13	
No	275	80	27	53	80	
Moderate education level (dummy)						(χ2=23.09; p=0.000**)
Yes	132	28	21	33	48	
No	235	67	10	39	45	
High education level (dummy)						(χ2=19.57; p=0.001**)
Yes	143	52	6	20	32	
No	224	43	25	52	61	
User group						
Self-employed worker (dummy)						(χ2=28.71; p=0.000**)
Yes	100	3	6	12	16	
No	267	92	25	60	71	
Company (2-10 employees) (dummy)						(χ2=11.74; p=0.019*)
Yes	91	17	15	17	24	
No	276	78	16	55	69	
Company (>50 employees) (dummy)						(χ2=19.48; p=0.001**)
Yes	96	46	8	27	27	
No	271	49	23	45	66	

* and ** indicate that the coefficient is significant at the 0.05 and 0.01 level

Table 37. The influence of the physical work environment on the location type choice

	Location type choice					
	1	2	3	4	5	Pearson Chi-Square
	# Interactions					
Office concept						
Group office (dummy)						(χ2=21.17; p=0.000**)
Yes	70	11	7	9	33	
No	297	84	24	63	60	
Open-plan office (dummy)						(χ2=35.14; p=0.000**)
Yes	183	77	12	42	45	
No	184	18	19	30	48	
Combi-office (dummy)						(χ2=24.79; p=0.000**)
Yes	89	6	12	21	14	
No	278	89	19	51	79	
Workspace type						
Together in a closed space (dummy)						(χ2=24.93; p=0.000**)
Yes	97	8	8	9	32	
No	270	87	23	63	61	
An open space without partitions (dummy)						(χ2=55.33; p=0.000**)
Yes	205	83	10	50	40	
No	162	12	21	22	53	
An open space with partitions (dummy)						(χ2=35.77; p=0.000**)
Yes	39	3	13	10	16	
No	328	92	18	62	77	
Workspace use						
A personal workspace (dummy)						(χ2=18.03; p=0.001**)
Yes	280	61	15	51	58	
No	87	34	16	21	35	
Workspace on rotation basis (dummy)						(χ2=29.88; p=0.000**)
Yes	26	8	10	6	2	
No	341	87	21	66	91	
Non-territorial workspace (dummy)						(χ2=18.035; p=0.001**)
Yes	61	26	6	15	33	
No	306	69	25	57	60	

* and ** indicate that the coefficient is significant at the 0.05 and 0.01 level

Table 38. The influence of interaction characteristics on the location type choice

	Location type choice					
	1	2	3	4	5	
	Mean					*F*
Duration (in minutes)	24.20	44.51	15.06	36.49	42.24	*(F=7.302; p=0.000**)*
	# Interactions					*Pearson Chi-Square*
Type of interaction						
Social interaction (dummy)						*(χ2=91.04; p=0.000**)*
Yes	75	12	17	49	29	
No	292	83	14	23	64	
Business interaction (dummy)						*(χ2=90.82; p=0.000**)*
Yes	251	78	6	18	49	
No	116	17	25	54	44	
Interaction (<1 person other organization) (dummy)						*(χ2=50.35; p=0.000**)*
Yes	75	16	18	21	45	
No	292	79	13	51	48	
Interaction with minimal 1 strong tie (dummy)						*(χ2=64.57; p=0.000**)*
Yes	279	41	18	28	50	
No	88	54	13	44	43	
Group interaction (> 3 people) (dummy)						*(χ2=63.43; p=0.000**)*
Yes	62	43	4	38	26	
No	305	52	27	34	67	
Type of main activity of the interaction						
Discuss/debate (dummy)						*(χ2=50.19; p=0.000**)*
Yes	184	41	8	8	25	
No	183	54	23	64	68	
Meeting (dummy)						*(χ2=10.71; p=0.030*)*
Yes	26	15	1	3	9	
No	341	80	30	69	84	
Catch up/chat (dummy)						*(χ2=31.68; p=0.000**)*
Yes	90	11	18	12	28	
No	277	84	13	60	65	
Giving or receiving advice (dummy)						*(χ2=9.48; p=0.050*)*
Yes	40	13	0	3	6	
No	327	82	31	69	87	

Table 38. Continued

	Location type choice					
	1	2	3	4	5	*Pearson Chi-Square*
	# Interactions					
Preplanned or unplanned						
Preplanned interaction (dummy)						(χ2=71.87; p=0.000**)
Yes	83	63	6	30	36	
No	284	32	25	42	57	
Coincidentally encountered/unplanned (dummy)						(χ2=30.13; p=0.000**)
Yes	88	14	19	17	31	
No	279	81	12	55	62	
Knowledge sharing						
Knowledge shared (dummy)						(χ2=45.92; p=0.000*)
Yes	248	70	15	21	58	
No	119	25	16	51	35	

With regard to the physical work environment (see Table 37), significant relationships were found between the office concept and the location type choice of face-to-face interactions. People working in an open space without partitions are more likely to have their interactions at the workspace than people working in other workspace types. In addition, people who have a fixed and personal workspace are more likely to use their or others workspace for face-to-face interactions than people who have a workspace on rotation basis or a non-territorial office. Table 38 showed that preplanned interactions are more likely to take place at meeting spaces compared to unplanned interactions. Also, the activity of the face-to-face interactions was found to be significantly related to the locations type choice. Face-to-face interactions, whereby knowledge was shared, are more likely to take place at the workspace than interactions whereby no knowledge was shared.

To analyze all expected effects on the location type choice simultaneously in a single model, a MMNL model approach was used. Table 39 shows the estimation results of the final MMNL model and Figure 11 shows a visualization of the significant relations of the MMNL model. Arbitrarily, Location 5 (Other location) is taken as the base alternative. As can be seen in Table 39, a value of 0.38 for adjusted Rho-square indicates that the model fit is satisfactory. The standard deviations of the error terms are significant for Location 1, 2 and 3, which means that there exists heterogeneity across business center users for these location choices. The average value estimates of

the parameters suggest that on average the base preferences for the workspace is the highest and at the coffee corner/pantry the lowest.

Table 40 shows the correlation matrix. As can be seen, high correlations exist between the utilities of the location alternatives. These correlations suggest that a strong competition exists between workspace and formal meeting space as well as between workspace and coffee corner/pantry for face-to-face interactions.

The non-random parameters show that men have less face-to-face interactions at their workspace than women, compared to the other location types. In addition, the results show that older business center users have fewer interactions at a café/restaurant/canteen than younger users. Self-employed workers have more interactions at their own workspace and fewer interactions at formal meeting spaces, compared to employees of SMEs or larger organizations. These workers have no colleagues and customers or other parties might visit them at their own office/workspace. Furthermore, keeping everything else equal, people who work more hours at the business center have interactions at the coffee corner/pantry more frequently than people who work fewer hours. Possibly, people who work more hours may have more opportunities to meet others at informal locations than people who work fewer hours.

Table 39. Results Mixed Multinomial Logit Model (between brackets are t-values)

Random parameters (location type)	Parameter (t-statistic)
1. Workspace	1.132*** (3.87)
2. Formal meeting space	-0.061 (-0.18)
3. Coffee corner/pantry	-3.037*** (-3.61)
4. Café/restaurant/canteen	0.860 (1.40)
5. Other location (Base-level)	0

Significant at 0.05 level, * Significant at 0.01 level

Table 39. Continued

Interaction variables (non-random parameters)	1. Workspace	2. Meeting space	3. Coffee corner	4. Café/ restaurant
Personal- and work related characteristics				
Male (dummy)	-0.438** (-2.05)			
Age				-0.030** (-2.11)
Freelancer/self-employed (dummy)	1.366*** (4.42)	-1.475** (-2.26)		
# Workhours per week			0.041** (2.04)	
Interaction characteristics				
Social interaction (dummy)		-1.345*** (-3.70)		2.277*** (5.49)
Unplanned interaction (dummy)			1.291*** (3.12)	
At least 1 person from another organisation (dummy)	-1.880*** (-7.00)	-1.224*** (-3.40)		
At least 1 person with strong tie (dummy)	1.058*** (5.11)			
Catch up/chat (dummy)				-2.621*** (-6.00)
Discuss/debates (dummy)	1.021*** (4.61)			
Giving/receiving advice (dummy)	1.036*** (2.98)			
Knowledge shared (dummy)				-0.761** (-2.04)
Physical work environment characteristics				
Open-plan office concept		1.572*** (5.15)		
Non-territorial workspace	-0.817*** (-3.42)			
Standard deviation	0.936***	0.926***	0.998***	0.364
Parameters	31			
Log Likelihood function (LL(β))	-650.600			
LL(0)	-1059.010			
ρ2	0.386			
ρ2 adjusted	0.378			

Significant at 0.05 level, * Significant at 0.01 level

Table 40. Correlation matrix random parameters

	1. Workspace	2. Formal meeting space	3. Coffee corner/pantry	4. Café/ restaurant
1. Workspace	1.000	-0.977	-0.820	-0.415
2. Formal meeting space	-0.977	1.000	0.863	0.331
3. Coffee corner/pantry	-0.820	0.863	1.000	0.657
4. Café/restaurant/canteen	-0.415	0.331	0.657	1.000

As expected, face-to-face interaction characteristics are important for the preferred location type where the interaction takes place. A social interaction increases the probability that the interaction takes place at a café/restaurant/canteen and decreases the probability that it occurs at a formal meeting space compared to work-related interactions. This confirms the intuition that these other locations are mostly social and/or informal spaces. Next, the probability that the interaction takes place at the coffee corner/pantry increases when the interaction is unplanned.

If the interaction is with more than one person from another organization, the propensity that this interaction takes place at the workspace or at a formal meeting decreases compared to interactions with only colleagues or with a group (i.e., more than 3 people). With regard to tie strength, results show that interactions with minimally one strong tie have higher probability to take place at the workspace compared to interactions with only weak ties and group interactions. Furthermore, the activity of the face-to-face interactions also shows interesting results. First, the propensity that people catch up or chat at a café/restaurant/canteen is lower than for other activities. This is remarkable because 72% of the chats/catch ups are social interactions. On the other hand, chats/catch ups have a shorter duration (a mean of 15 minutes) compared to other activities (a mean of 35 minutes). Interactions at a restaurant/café are more likely to be pre-planned and of a longer duration (a mean of 36 minutes). Possibly for that reason the activity catch up/chat is more likely to take place at another location than a café/restaurant/canteen. Next, discussion or receiving/giving advice increases the probability that the interaction takes place at a users' workspace. If knowledge sharing occurs during the interaction, the probability that the interaction takes place at a café/restaurant/canteen, decreases. This might be caused by the fact that most interactions at a café/restaurant/canteen are social interactions (68%).

With regard to the physical work environment of individuals also some interesting interaction effects with the location choice emerge. Business center users who work in an open-plan office are more likely to have a face-to-face interaction at a formal meeting space, compared to people who work at other office concepts (i.e., cellular office, combi-office or group office). A possible explanation is that these users do not want to disturb other workers when they have an interaction at the business center. People who work at a non-territorial workspace (i.e., flexible used workspace) less frequently have a face-to-face interaction at the workspace. This might be caused by the fact that these users do not have a fixed workspace and therefore they might not be able to find or disturb other workers when they want to have an (unplanned) interaction with them. This finding is also related to the high negative correlation between the workspace and the other location types (see Table 40). Thus, people who do not frequently have face-to-face interactions at their workspace, have more interactions at the other location types (i.e., formal meeting space, coffee corner, canteen or at other locations).

5.4.3 Discussion and conclusion

Although there is a growing interest in people's interaction behavior in the workspace, research on actual face-to-face interactions and their characteristics, is still limited. Specifically in business centers, where organizations share workspaces and facilities, more research is needed on inter- and intra-organizational interaction behavior. This study contributes to this research gap, by analyzing the effects of interaction characteristics, personal- and work related characteristics and characteristics of the physical work environment on the location where face-to-face interactions take place in a business center. Understanding interacting behavior within and between organizations in business centers is important for designing optimal interactive work environments. It also provides organizations with new insight on which locations in business centers are important for employees to interact and share knowledge with others. Where previous studies mainly focused on the frequency of interacting or measured the overall subjective interacting behavior using questionnaires, this study contributes to existing theory by analyzing the location of face-to-face interactions using real-time behavioral data, collected by an Experience Sampling Method.
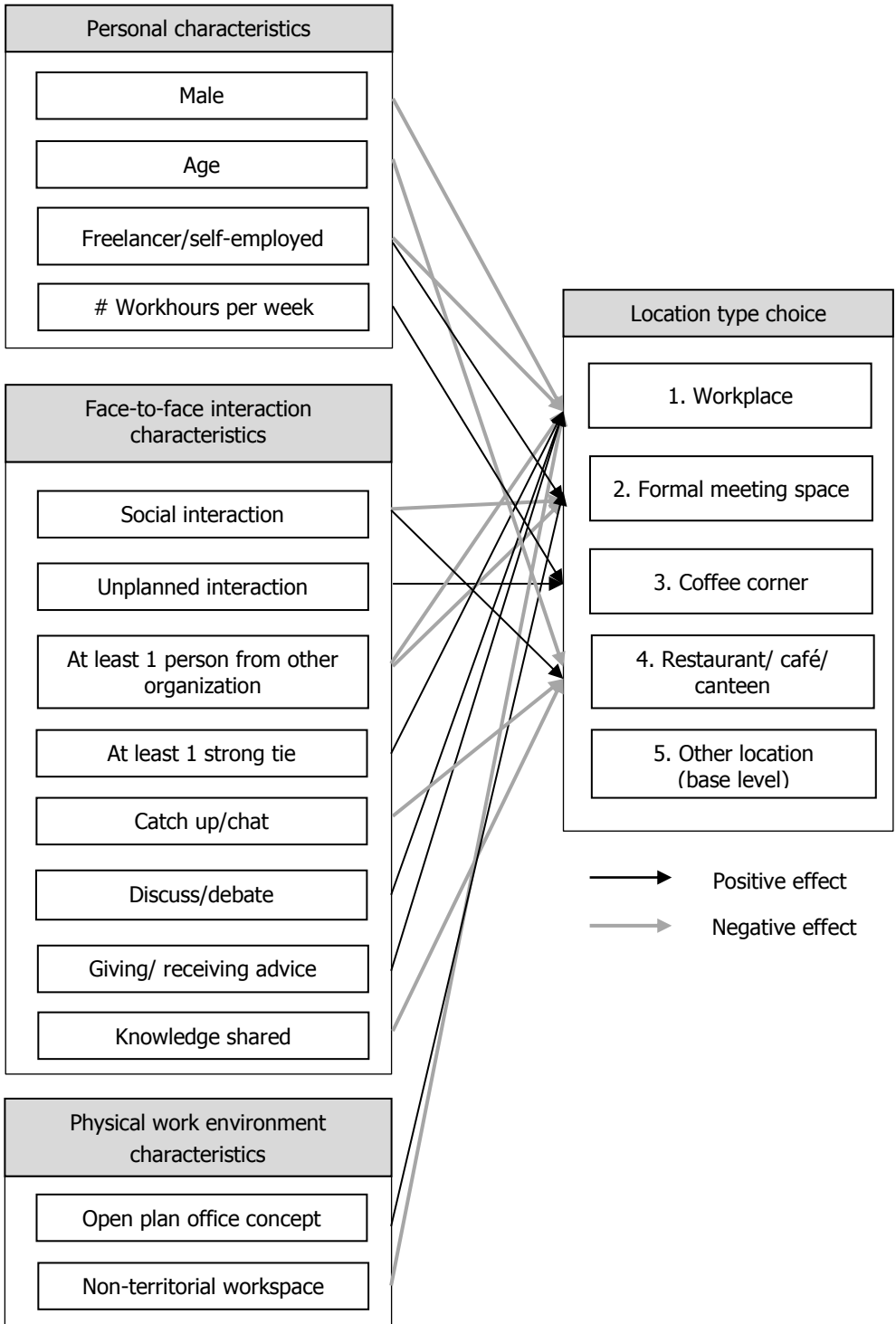
Figure 11. Visualization of the MMNL model location choice

With regard to the descriptive statistics of the face-to-face interactions, findings suggest that working with other organizations in the same building (i.e., physical proximity) could lead to inter-organizational interactions (i.e., 26% of the interaction are with minimally one person of another organization). In addition, these interactions were also found to be more frequently coincidental compared to intra-organizational interactions and thus are more likely to be a result of the physical work environment (Peponis et al., 2007; Toker and Gray, 2008). This is specifically important for smaller organizations, which is the main target group of business centers, as they rely more on their business and social network outside of their own organization (e.g., Thorpe et al., 2005; Lechner et al., 2006). In addition, organizations could improve their performance by networking and eventually sharing knowledge with other organizations (Easterby-Smith et al., 2008). As this study only focused on intra- and inter organizational interactions within a building, for future research it would also be interesting to analyze interactions across organizations that do not share a building.

Furthermore, compared to studies in single-tenant offices (e.g., Becker and Sims, 2001; Boutellier et al, 2008; Appel-Meulenbroek et al., 2017), the duration of the interactions in the business centers was much longer (on average 30 minutes). However, in this study also group interactions were taken into account (i.e., more than 3 people) and interactions that were more than just a greeting. Future research could look more into the duration of interactions and content of interactions in different office settings.

Next, the results showed that specifically the content of face-to-face interactions is important for explaining the location where an interaction takes place. Social interactions take more frequently place at a café/restaurant/canteen and less at formal meeting spaces, compared to other types of interactions. It is also recognized in single-tenant offices by Davenport and Bruce (2002) that café areas facilitate social interactions among workers. Social interactions are important to build trust, soften cultural differences between organizations and eventually increase knowledge sharing (e.g., Bøllingtoft and Ulhøi, 2005, Easterby-Smith, Lyles, and Tsang, 2008). Next, unplanned interactions take place more frequently at a coffee area than unplanned interactions. This underlines the importance of a coffee area to meet new people beyond the current social circle, which could lead eventually to new insights and knowledge (Granovetter, 1983; Xerri and Brunetto, 2010). Property managers of business centers could, therefore, create attractive café and coffee areas to facilitate and stimulate social and unplanned face-to-face interactions within and between organizations. On the other hand, this study showed that these café areas are not

important places where knowledge is frequently shared. Knowledge sharing takes more often place at other locations such as the workspace and formal meeting spaces. The workspace and meeting rooms were also found to be important knowledge sharing facilities in single-tenant offices (Staplehurst and Ragsdell, 2010). Therefore, property managers that focus on creating an innovative work environment could better create attractive meeting spaces and work environments that fit all needs/activities of their occupants (Gerdenitsch et al., 2017), than to focus on social or informal spaces (e.g., coffee areas). For future studies it is interesting to analyze how the work environment could be designed with a good balance between social- and private spaces and collaboration and concentration spaces.

Users of business centers, who work at a non-territorial office, less often use their workspace to interact with others. On the other hand, findings of this study also suggest that the workspace is an important location for discussions and giving or receiving advice. These activities were also determined to be important business interactions among occupants of incubators (Cooper et al., 2012). Attractive workspaces could be designed with a higher visibility and accessibility to facilitate these activities more (Rashid et al., 2009). Business centers that offer flexible office space (i.e., non-territorial office space) could focus more on designing other attractive and interactive spaces (e.g., informal meeting, lounge or coffee areas) to stimulate unplanned social interactions among occupants (e.g., Hua et al., 2011; Kastelein, 2014).

As expected, people who work in an open work environment more frequently use a meeting space for interacting. These people probably do not want to disturb other workers or want more privacy when they have an interaction (Brennan et al., 2002). For business centers that offer open-plan office space, it is important that also meeting spaces are offered that are accessible and in close proximity of people's workspace. It is, namely, recognized that people who work in close proximity of meeting spaces use these spaces more often (Brager et al., 2000). It thus remains a challenge for office designers to create a balanced physical work environment that facilitates the advantages of both open- and traditional closed workplaces (Horr et al., 2016).

With regard to the personal- and work related characteristics, the findings show that older workers less frequently use a café/restaurant/canteen for face-to-face interactions. However, this location is an important facility for social interactions (e.g., Davenport and Bruce, 2002), which are important to build relationships within and with other organizations. Therefore, organizations could try to stimulate their older employees to use these facilities more often. For property managers it is important to monitor the users of their business centers, so they can adapt to their preferences with

regard to interacting. For future research it is interesting to look into generation differences with regard to the incentives to use spaces/facilities for specific interaction activities. Older employees have a more traditional style of working and prefer different communication modes compared to younger employees (De Been et al., 2014; Brčić and Mihelič, 2015) and thus probably also have different incentives to use spaces for interacting. Furthermore, this study showed that people who have more interactions at their workplace have probably less interactions at other locations. For future research it is therefore interesting to investigate why some people interact more at the workplace and others at other places.

This study also offered new insights with regard to the differences between inter- and intra-organizational face-to-face interactions at the scale of a business center. It is less likely that inter-organizational interactions take place at the workspace or at a formal meeting space, compared to intra-organizational interactions. These interactions take place more frequently at shared spaces such as the coffee corner, café/restaurant/canteen or at other locations (mainly social or informal spaces). Organizations that want to network with other organizations should stimulate their employees to use more frequently these shared spaces. It is also recognized by previous studies that people from different groups have different interaction patterns (Agneessens and Wittek, 2012; Wineman et al., 2009; Kabo et al., 2013). More in-depth research is needed that focuses specifically on inter-organizational interactions and how these are facilitated the best by the physical work environment of business centers.

For a significant share of face-to-face interactions, business center users reported other locations (14%). This was not expected, because previous studies in single-tenant offices mentioned meeting spaces, workspaces, coffee areas or a café/canteen as the most important locations for face-to-face interactions (e.g., Boutellier et al., 2008, Hua et al., 2011; Kastelein, 2014). Thus, probably in business centers, other spaces are offered that also facilitate interactions. Analyzing the importance of these other locations for interaction patterns within and between organizations is interesting for future research.

5.5 Conclusion

The aim of this chapter was to analyze the location choice of face-to-face interactions and real-time knowledge sharing behavior in business centers. Results of the MMNL model on knowledge sharing types showed that tacit knowledge is shared more frequently during discussions/debates, formal meetings and when receiving or giving advice. In addition, people share more often explicit knowledge during pre-

planned interactions than during unplanned interactions. The propensity that explicit knowledge is shared during inter-organizational interactions is lower than during intra-organizational interactions. Thus, probably more tacit knowledge is shared during inter-organization interactions. Men share explicit knowledge more frequently than women and freelancers/self-employed workers share explicit knowledge less frequently than people working for an organization. With regard to the physical work environment, people working in a cellular office, share les frequently tacit knowledge than people working in another office concept.

The second MMNL model was estimated to analyze the effects on the location choice of face-to-face interactions in business centers. Results showed that the probability is higher that an unplanned interaction takes place at the coffee corner/pantry compared to planned interactions. Inter-organizational interactions take place less frequently at workspaces or formal meeting spaces and more frequently at shared spaces such as the coffee corner or at café/canteen compared to intra-organizational interactions. The workspace is an important location for discussions/debates or for giving/receiving advice among workers. With regard to the physical work environment, the results of the MMNL model showed that people working in an open-plan office are more likely to interact at meeting rooms and people working at a flexible workspace interact less at their workspace. Knowledge sharing is less likely to take place at a café/canteen, compared to other locations.

Thus, overall the analyses showed that especially personal characteristics and interaction characteristics (e.g., activity or type) are important for explaining knowledge sharing behavior. The physical work environment appeared to be less important. To stimulate interaction between organizations property managers need to offer attractive informal/social shared spaces. On the other hand, to increase face-to-face interaction patterns within organizations than the focus needs to be more on designing attractive and visible workspaces.

6

Conclusion and recommendations

6.1   Summary and findings

The aim of this thesis was to identify business center concepts and to analyze the influence of characteristics of these business center concepts on networking and knowledge sharing behavior between users of the same business center. To achieve this aim, the following research questions have been addressed:

- Which types of business center concepts can be identified and how do they differ from each other?

- What is the influence of physical and non-physical aspects of business centers on networking and knowledge sharing behavior?

- At which locations inside business centers does specific networking and knowledge sharing behavior take place?

To answer the first research question, a questionnaire on business center characteristics (i.e., objective, tenants, spaces, atmosphere, facilities/ services, business model, type of property and capacity of the business center) was designed. Data was collected in 2015 among owners/managers of 446 business centers in the Netherlands. The questionnaire was completed by owners/managers of 139 business centers (30%). To answer the second research question, a questionnaire was designed that consisted of open and multiple choice questions about personal- and work related characteristics, physical work environment characteristics and perceived networking and knowledge sharing behavior. Data was collected between January and February 2016 in 53 business centers in the Netherlands, which is a subsample of the 139 business centers who also participated in 2015. Finally, a data collection instrument was designed to answer research question 3. This data collection instrument consisted of two parts, namely a questionnaire and Experience Sampling Method (ESM). The questionnaire included open- and multiple choice questions about personal-, work related characteristics and characteristics of users' work environment. In addition, users were asked to indicate whether they were willing to participate in the second part of the research (i.e., ESM). With regard to ESM, business center users received signals (i.e., smartphone and/or e-mail prompts) with a link to the online questionnaire where they could report their face-to-face interactions in the business centers. They were asked to report characteristics of face-to-face interactions they had in the business center 60 minutes prior to three random times a day for 10 workdays. Data were collected between May and June 2017 among users of seven business centers in the Netherlands. These seven business centers were coworking offices and serviced office or a combination of these two

concepts and all focus on stimulating networking, knowledge sharing and creating a community among organizations.

Based on the literature review, four types of business center concepts can be distinguished, namely regular business centers, serviced offices, coworking offices and incubators. In Chapter 3, differences between these business center concepts and the characteristics that define them were analyzed using explorative data analyses (i.e., Chi-square analysis and t-test). The analyses showed many significant differences between the business center concepts. First, regular business centers appear to exist longer than the other business center concepts, have no specific objectives, offer mostly a one year, 2 year or a 5 year lease contract, offer a low number of different (shared) spaces, and have a low service level. Serviced offices are mostly newer business centers, are profit oriented, have many objectives, are oriented on SMEs, self-employed people and independent workers, offer a lot of different (shared) spaces, have a high service level, mostly based on a 'pay as you use' principle and offer workspaces based on a one hour, one day or one month lease contract. Furthermore, coworking offices have the objective to stimulate knowledge transfer and to create a working community. These offices offer social and collaborative spaces, mostly based on a one year lease contract, have a high number of different spaces and offer catering and the use of coffee and tea makers. Finally, incubators appear to be mostly nonprofit oriented, have as objectives to support and facilitate start-up enterprises and to stimulate economic development and growth in the region, and are focused on start-up enterprises. Thus, the analyses show that the four concepts of business centers in the literature also exist in the market and indeed have unique selling points to attract tenants. However, the results did not show significant differences with regard to the physical office building characteristics of the concepts.

In order to analyze the effects of physical and non-physical aspects of business centers on perceived networking and knowledge sharing behavior, two path analysis models were estimated and a seemingly unrelated regression analysis was used in Chapter 4. First, a path analysis model was estimated to analyze the direct- and indirect effects of the physical work environment of business centers on knowledge sharing, mediated by the effects of networking and controlling for personal- and work related characteristics. Results showed that shared facilities/spaces (i.e., restaurant/canteen, event space or lounge room) are important for networking and sharing inter-organizational knowledge. In addition, flexible workspaces in an open work environment also stimulate knowledge sharing with people from other organizations. Meeting spaces were found to be important knowledge sharing facilities for networking with colleagues.

To analyze the direct- and indirect effects of non-physical characteristics of business centers on networking and knowledge sharing behavior, another path analysis model was estimated. The results showed that with regard to the use of offered services, only the use of consultancy services and workshops/lectures have a positive effect on networking and knowledge sharing with people from other organizations in the same business center. Especially personal characteristics (i.e., age, gender, education level) and work-related characteristics (i.e., number of hours and years working in the business center) were found to influence perceived networking and knowledge sharing inside the business centers. The results also showed that extraverted people have a larger perceived business- and social network than introverted people and traditional/uncreative people share less knowledge with people from other organizations than creative people.

Finally, a seemingly unrelated regression analysis (SUR) was used to analyze the influence of personal- and organizational characteristics on sharing different types of knowledge within and between organizations in business centers. The four types of knowledge that were distinguished were public non-codified knowledge, public codified knowledge, private non-codified knowledge and private codified knowledge. By using a SUR, multiple regression equations, with different dependent variables (i.e., knowledge types) that are related to each other and different sets of independent variables (i.e., personal- and organizational characteristics), are analyzed at the same time. The results show that public and private non-codified knowledge is more frequently shared with people from other organizations and by those who more frequently use an event space, lounge space, canteen or consultancy services. Sharing private non-codified knowledge (i.e., tacit knowledge) is important for organizations to increase their innovative capabilities. Knowledge sharing within organizations was influenced by the use of individual closed workspaces, meeting spaces and a restaurant/canteen and gender.

The aim of Chapter 5 was to analyze the preferred location for face-to-face interactions and knowledge sharing within and between organizations in business centers. Based on real-time data collected between May and June 2017 among 100 users of seven business centers in the Netherlands, a Mixed Multinomial Logit model was estimated to analyze the influence of the physical work environment on business centers users' propensity to share different types of knowledge, controlling for several personal- and face-to-face interaction characteristics. Results showed that for men the propensity of sharing knowledge that can also be documented appears to be higher than for women. Knowledge that is also available in a documented form is shared less frequently by freelancers and self-employed workers, than by people working for a

larger organization. Moreover, a cellular office was found to have a negative effect on sharing tacit knowledge during an interaction. Finally, the propensity that tacit knowledge is being shared is higher during discussion/debate interactions, meetings and when information is received or given. A second MMNL model was estimated to analyze which locations in business centers are important for users to interact and share knowledge with others. Results showed that inter-organizational interactions take place less frequently at workspaces or formal meeting spaces and more frequently at shared spaces such as the coffee corner, café/restaurant/canteen or at other informal spaces than intra-organizational interactions. With regard to knowledge sharing, café areas were found to be locations where the probability that knowledge is shared decreases. Knowledge sharing might take place more often at other locations such as the workspace and formal meeting spaces.

6.2 Theoretical and practical implications

Business centers are often branded by property managers as innovative work environments, where it is expected that (people employed by) organizations network and share knowledge due to the shared spaces, facilities and services. It is also recognized that business centers are valued by tenants, because of knowledge sharing opportunities with other organizations. Therefore, the number of business centers (e.g., incubators, serviced offices and coworking spaces) increased globally over the past decades. However, empirical evidence that networking and knowledge sharing behavior takes place in business centers and to what extent this behavior is facilitated through the physical work environment of business centers was still missing. Up till now, most research focused exclusively on single-tenant offices and specifically on the frequency of face-to-face interactions or knowledge sharing within a single (large) organization. Therefore, one of the main contributions of this thesis is that it tests existing theory on knowledge sharing in single-tenant offices within in a different (shared) office context (i.e., business center) and simultaneously creates new theory on how to support knowledge sharing between organizations in business centers. The models that were estimated provide interesting results that give more insight in whether, how and where organizations share (different types of) inter- and intra-organizational knowledge. This thesis showed empirical evidence that the physical work environment in the context of a business center as well as users' personal- and work related characteristics indeed influence networking and knowledge sharing behavior. Furthermore, a major strength of this thesis is the use of the MMNL model approach in Chapter 5 to simultaneously investigate the effects of personal and work-related characteristics and interaction

characteristics on users' knowledge sharing behavior in business centers, because it can capture unobserved heterogeneity and is more flexible compared to other discrete choice models. Over the past years, this method has been increasingly used in several other research fields (e.g., retail or transportation choice behavior) (e.g., McFadden and Train, 2000; Zhu and Timmermans, 2011). Although this is an effective method to handle panel data and measure people's behavior in the built environment, the use of this method in workplace research is still limited.

With regard to the physical characteristics, results from this thesis showed that the office concept, workspace type and workspace use play a relevant role in explaining networking and knowledge sharing. The path analysis model showed that individual workspaces (i.e., fixed workspace) negatively influence networking and knowledge sharing within organizations. In addition, the MMNL model showed that the probability that tacit knowledge is shared decreases when people work in a cellular office concept. It is recognized that sharing tacit knowledge is the most important for organizations to increase their creativity and innovation processes (e.g., Nonaka et al., 2000; Marouf, 2007). Therefore, owners or managers of business centers that aim at stimulating knowledge sharing between users in their buildings could offer a more open- and flexible work environment.

Furthermore, the models showed important locations in business centers for networking and knowledge. The path analysis model showed that using an event space or a restaurant frequently increases networking with other organizations and frequently using a lounge space increases knowledge sharing with others. The MMNL model, based on real-time data, confirmed that the probability is higher that inter-organizational interactions take place at the workspace and in formal meeting spaces than at other locations. Thus, property managers of business centers who aim to create an interactive work environment could focus mainly on offering a variety of informal meeting spaces as unique selling points. On the other hand, for organizations that want to stimulate networking and knowledge sharing within their own organization, spaces for copying/printing, workspaces and meeting spaces are highly important. This is also recognized by studies on single-tenant offices (e.g., Boutellier et al., 2008; Hua et al., 2010; Staplehurst and Ragsdell, 2010; Kastelein, 2014).

The models showed that personal- and work related characteristics, namely age, gender, education level, personality, hours working, business club membership and organization size are also important for explaining networking and knowledge sharing behavior. These results underline the importance for property managers to monitor

users' behavior in business centers and adapt the physical work environment to their preferences with regard to interacting and knowledge sharing.

6.3 Wider perspective

This dissertation confirmed that open work environments and flexible workspaces are important for stimulating intra- and inter organizational networking and knowledge sharing. However, it is still unknown what the 'perfect' balance is between the openness and flexibility of office design for enhancing communication and collaboration versus closed workplaces for concentration and privacy needs. Many large organizations implemented Activity Based Working (ABW) in their own offices, which provides a variety of workspaces to accommodate different work activities (Candido et al., 2018), to offer a balanced office environment with open- and closed workspaces. However, previous studies also reported disadvantages of this new office design, such as the difficulty of finding an appropriate workspace and the misusage of workspaces (e.g., people talking in the concentration rooms or people claiming flexible workspaces) (Arundell et al., 2018). Therefore, property managers or HR managers should monitor the preferences and needs of workers with regard to office space, so they can adapt the physical work environment easily to these preferences. This could increase the productivity, job satisfaction and user experience of workers, which eventually could help to attract and retain talented knowledgeable workers (e.g., Earle, 2003; Haynes, 2011).

Furthermore, this dissertation showed the importance of personal characteristics (e.g., age, gender, education level or personality) for explaining (networking and knowledge sharing) behavior in offices, which also underlines the importance of monitoring users' perspective with regard to the physical work environment. Flexible work environments could be created that can be easily adapted to fit to the needs and preferences of their different users. However, not only the physical work environment is important for increasing workplace satisfaction, but also the use of (new) technologies and the cultural/social context of an organization are important. In addition, the management style of an organization could also be important for employee satisfaction. Future research should take into account these aspects.

Besides knowledge sharing, this dissertation showed that face-to-face interactions are also important for increasing workplace interpersonal relations. Furthermore, it is recognized that people who feel lonely at work also have a lower job performance (Ozcelik and Brasade, 2018). Work relationships play a key role in promoting employee flourishing (Colbert et al., 2016) and innovative behavior (Scott

and Bruce, 1994). So, when organizations implement hot-desking or ABW, they also could implement technology and offer services to enhance communication within and between organizations. For example, by using interactive maps to find colleagues or others, offering an online knowledge sharing platform and organizing networking events.

Another study of business centers showed that managers or board members are more satisfied with the physical work environment of business centers compared to regular employees (Hartog et al., 2018). This signals the importance of organizations to involve their employees in the decision-making process with regard to the physical work environment (e.g., selecting a new office or with the design of the office) and to monitor frequently users satisfaction after decisions. Organizations are constantly changing and thereby also their office environments. Therefore, it is important to have a change management strategy that includes the participation of employees. If employees already participate in the planning of organizational or workplace change could increase their support for that change (e.g., Coyle-Shapiro, 1999). Therefore, property managers of business centers who want to create innovative work environments could also involve their users in their decisions, with regard to changes in work environment, and monitor their behavior.

Related to workers productivity and user satisfaction, worker's well-being or health has received increased attention (e.g., Cooper et al., 2015; Olsen et al., 2017). Workers sit most of the time in office buildings, which could have negative effects on workers' health conditions (Evans et al., 2012; Saidj et al., 2014) and eventually decrease productivity, employee satisfaction and the overall success of organizations. In addition, increasing workers happiness/wellbeing or satisfaction has become very important for organizations due to the worldwide 'war for talent' (e.g., Tung, 2016). Wellbeing of employee's is also related to the social wellbeing in the work environment (e.g., face-to-face interactions). This dissertation showed the importance of face-to-face interactions for knowledge sharing behavior within and between organizations. More insight in employee's behavior at work may help organizations to stimulate more healthy behavior (e.g., by adapting the physical work environment or offering health services), to reduce sickness absence, and increase talent retention.

6.4   Limitations and directions of future research

Although this study provides interesting results on networking and knowledge sharing behavior in business centers, some challenges for future research remain. As data was already collected on business center concepts in 2014, probably new business

center concepts emerged since then. Therefore, further research in this area needs to analyze, besides the four business center concepts used in this study, whether other business center concepts can be identified and what their unique selling points are. Also, it would be interesting to analyze user characteristics and how users of the different business centers experience these concepts. For this first part of this thesis (i.e., Chapter 3), data is collected from 139 business centers in the Netherlands. The dataset includes business centers from all different types of business center concepts, spread over various construction periods. However, using a larger dataset of business centers and of different countries is likely to enhance the validity and reliability of the findings. Moreover, comparing the results of this study of Dutch business centers to those in other countries will serve to develop a taxonomy of business center concepts that is generally applicable.

In Chapter 4, only the perceived use of the building and networking and knowledge sharing behavior was analyzed. Future research should analyze real-time objective behavior and more detailed information of networking behavior and knowledge sharing. For example, by including more detailed information on the physical work environment (e.g., interior or lay-out) and on face-to-face interactions (e.g., location in the building or proximity) between people (not colleagues) who work in a business centers. A major limitation of the analyses in Chapter 4 is the generalizability of the results, because of the small sample size. It is not clear if these findings could be generalized to all types of business center(s) (users). In addition, the sample contains only users of business centers in the Netherlands. Furthermore, because there will be some overlap between the responses of users of the same building, future research should perform multi-level analyses to handle this problem.

Using the Experience Sampling Method in Chapter 5, to capture real-time networking and knowledge sharing behavior, has several advantages (e.g., minimizing memory biases). However, using this method also led to several limitations in this study. This method only captured a small range of knowledge sharing behavior. Little is known about the setting or context of this behavior (e.g., mood of participants, personality and willingness to share knowledge). Next, the time-consuming and commitment aspect, compared to a traditional survey, for the respondents led to a low response and thus a small sample size and possibly a non-random sample (when selective drop outs occurred). A more representative and larger sample of users could increase the interpretation and generalizability of the results. In addition, data from different countries could give more insight into cultural differences with regard to knowledge sharing. The key challenge for future research in business centers is to

search for novel methods to collect high quality data whereby the commitment of respondents is limited, for example by using sensors (e.g., WIFI, RFID or iBeacon etc.) to track people behavior. In-depth interviews could be used in future studies to gain more understanding of users' thoughts and behavior in business centers.

Another limitation of the analyses in Chapter 5 is the difficulty of causal interpretation of the relationships between knowledge-sharing type and other interaction characteristics (e.g., for example, the knowledge type might be decided first and the interaction type next instead of vice versa). Such causal interpretations cannot be made. Although these causal interpretations cannot be made, the analyses nevertheless revealed the relationships between location and characteristics of the face-to-face interactions. Further research is needed to look at the direction of the causal relationships.

Overall, several characteristics of the physical work environment were not included in this thesis that could be important factors for knowledge sharing, namely the distance between the workspace and facilities (e.g., Wineman et al., 2014), the actual lay-out of a business center, the exact location of facilities, or the proximity between people. Furthermore, research has recognized that knowledge sharing is dependent on several other context variables such as trust (Levin and Cross, 2004), personality, (Gupta, 2008), organizational culture (Xerri and Brunetto, 2010), structure (Chen and Huang, 2007), and technological context (Ismail and Yusof, 2010). In addition, behavior in the workplace is very dynamic through for example, private life-cycle events (e.g., moving, becoming a parent, illness, death of a spouse) and thus more interdisciplinary empirical research on this topic is needed. Further research on this topic needs to include these variables, which could result in an even more comprehensive model to analyze knowledge sharing in business centers in more depth.

Another limitation of this dissertation is that the content of the knowledge that was shared within and between organizations was not taken into account. Including more information about the content in future research, would help to give more insight in the added value of these knowledge sharing interactions in business centers. In addition, analyzing the purpose of the knowledge that was shared is interesting to analyze for future studies (e.g., better support of decisions, innovation in processes or products etc.). In addition, the outcomes of knowledge sharing behavior between organizations were not taken into account. Future research on knowledge sharing in business centers should look into the impact of working in a business center on for example the number of collaborations, patents (i.e., for high tech business centers such

as incubators) or growth in revenues. This could help to give more insight into the added value of business centers.

This thesis focused on networking and knowledge sharing behavior and how the physical work environment facilitates and stimulates this behavior, but does not show the preferences and needs of business center users with regard to their work environment. As business center users (i.e., SMEs and self-employed workers) are a specific target group and differ from large tenants of single-tenant offices, future research is needed on user preferences with regard to characteristics of the different business center concepts. Next, because price and location are often important aspects for choosing an office space (e.g., Weijs-Perrée et al., 2017), it would be interesting for future research to analyze the willingness to pay of SMEs and freelancers/ self-employed workers (i.e., main target group of business center) with regard to characteristics of the physical work environment to rent an office space in a business center.

The traditional/uncreative and extravert/enthusiastic personality traits were found to have an impact on networking and knowledge sharing behavior. As personality influences people's networking and knowledge sharing behavior, it is also expected that personality influences preferences with regard to the physical work environment. More in-depth research is needed to analyze preference differences with regard to personalities so that property managers of business centers are able to steer more on their users' preferences to attract and retain more tenants. In addition, future research is needed on how networking and knowledge sharing between organizations can be stimulated by different stakeholders (e.g., HR managers, CREM managers, property managers and management of organizations).

For future research, it would also be interesting to analyze if the knowledge sharing behavior of users matches with the goals of developers and investors of business centers. In addition, more research is needed to look at (sustainable) knowledge sharing alternatives (e.g., online knowledge sharing platform or events) within business centers. Using interviews among property managers, developers and investors could give more in-depth insights in their problems and considerations.

Furthermore, only face-to-face interactions were taken into account in this study. Using online communication forms (e.g., e-mail, Skype, FaceTime, Social Media and online knowledge sharing platform) could also provide opportunities for organizations to share knowledge (e.g., Razmerita et al., 2016). Future research should also look into the influence of building design on the use of different communication forms for knowledge sharing behavior in business centers.

Overall, this dissertation provides deeper understanding of knowledge sharing and networking behavior within and between organizations in business centers, where organizations share office space, facilities and services. It opens up various new avenues for future work in the area of workplace research.

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Subject index

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Curriculum Vitae

Minou Weijs-Perrée was born on the 15th of September 1989 in Venlo, The Netherlands. Minou studied at the department of the Built Environment at Eindhoven University of Technology and received her Bachelor's degree in 2012, followed by a Master's degree Architecture, Building and Planning in 2014. She graduated within the Real Estate Management & Development group with a thesis focusing on the relationships between personal- and neighborhood characteristics, social networks and social satisfaction of elderly. From October 2014 she started a PhD project at Eindhoven University of Technology at Eindhoven, The Netherlands, of which the results are presented in this dissertation. Minou presented her research at various international scientific conferences and has been published in leading journals such as Building Research & Information, Property Management, Environment and Behavior, International Journal of Strategic Property Management, Facilities and Journal of Transport Geography. During her PhD she won the EuroFM Best Paper Award EFMC 2017 and Property Management 2017 Highly Commended Award and has acted as a reviewer for journals such as Behaviour & Information Technology, Journal of Corporate Real Estate and Nordic Journal of Surveying and Real Estate Research.

Publication list

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