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Tenants' willingness to pay for healthy office workplace aspects

the identification of healthy office workplace aspects that are beneficial to invest in by landlords through investigating preferences of tenants regarding trade-offs between particular aspects

Buskermolen, W.

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TENANTS' WILLINGNESS TO PAY FOR HEALTHY OFFICE WORKPLACE ASPECTS

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Author
W. (Wietse) Buskermolen
Student number: 0809340
wietse_buskermolen@hotmail.com

Supervisors
dr.ir. H.A.J.A. (Rianne) Appel-Meulenbroek
prof.dr. T.A. (Theo) Arentze
dr.ir. A.D.A.M. (Astrid) Kemperman

Company
CBRE Global Investors (NL) B.V.
Advisor: V. (Vincent) van den Putten
Asset Manager Dutch Office Fund

TU/e

EINDHOVEN UNIVERSITY OF TECHNOLOGY

PREFACE

This graduation thesis is the final product that marks my completion of the mastertrack Urban Systems & Real Estate at the Eindhoven University of Technology. During this research, I experienced and learned how the office workplace can positively influence one's health and in turn can enhance organizational performance. I now believe that healthy office workplaces are not only beneficial for office users, but also for the stakeholders that invest in such workplaces. Hopefully, the knowledge from this research will contribute to scientific research as well as to the awareness and practical application of healthy office workplaces.

The development of this research has come to a joyful end with the help of my supervisors Rianne Appel-Meulenbroek, Theo Arentze and Astrid Kemperman. I would like to thank them for their guidance, support and constructive feedback.

Furthermore, I would like to thank CBRE Global Investors for giving me the possibility to execute my graduation research as an intern of team of the CBRE Dutch Office Fund. In particular, I would like to thank Vincent van den Putten for helping and sharing his ideas, knowledge and experience which made this final product to a better result.

I hope you enjoy reading,

Wietse Buskermolen
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SUMMARY

Introduction

Because labor costs are covering a considerable share of organizations' total operating costs, it is important for organizations to nurture their human capital. Hence, organizations increasingly acknowledge the importance of the protection and promotion of the health and wellbeing of their workers. In modern society, work-related omission due to psychosocial workload is increasing which cost Dutch organizations a lot of money due to reduced organizational performance. This especially concerns organizations that perform service work and knowledge-based activities since their labor costs are frequently higher than many other branches of industries. Moreover, that workforce is often operating in office workplaces of which multiple studies have proven that such workplaces influence workers' performance, health and wellbeing in terms of job satisfaction, cognitive workload, interpersonal relations, physical activity and mental stress. The outcomes of healthy office workplaces are mentioned in various previous research and do not only provide protection for workers from physical health risks such as accidents, injuries or sickness that lead to absenteeism and presenteeism including spillover effects on colleagues. Additionally, the healthy office workplace does also promote positive health that leads to increases in workers' job satisfaction, morale, commitment and motivation. In turn, organizations profit from higher productivity, organizational effectiveness, competitive advantages and positive influences on attracting and retaining talent. These organizational performance outcomes can increase the demand of organizations for healthy office workplaces. That can be interesting for landlords since they normally rent office space to organizations and they can substantially influence the quality of the office workplace of their properties. In that way, investing in healthy office buildings can be beneficial for landlords by charging higher rents for the better quality of the building. Likewise, vacancy can be less due to quicker lease-up accordance and retaining tenants which in turn can lead to lower future replacement investments and higher building valuations.

Nonetheless, it is difficult to allocate and measure the specific financial consequences of office workplaces that possibly enhance the health and wellbeing of the workers who occupy them. Past research is mainly focused on office workplace productivity of which the 'holy grail' of measuring knowledge productivity seems intangible since it is dependent on a complexity of influences. Such complexity also accounts for health and wellbeing although some investigations attempted to provide an overall business-case or an overview of practical implementations to measure compare workplace health and wellbeing.
Past research that is conducted in the context of health and wellbeing in office workplaces has limitations regarding the influence of decision makers on the implementation workplace accommodation, being tenants of office space which in turn are dependent on the investments of the landlords they are renting from. Moreover, office workplace aspects that could advance the health and well-being of office workers are often studied by their individual applicability instead of aggregating them in one study. Therefore, this research attempted to identify which healthy office workplace aspects are beneficial to invest in by landlords through investigating preferences of tenants regarding trade-offs between particular aspects. This is done by measuring the preferences of tenants regarding all healthy office workplace aspects that can be influenced by landlords, including tenants' willingness to pay. The results help real estate owners to set up a strategy that meets the preferences of tenants for healthy office workplaces.

Methodology

To identify preferences of tenants, a Stated Choice experiment is executed among decision makers of office workplace accommodation of their organizations. The experiment is conducted among tenants that lease from the CBRE Dutch Office Fund that is focused on multi-tenant business centers on prime office locations. The Random Utility theory applies to the experiment, assuming that a respondent makes a choice that fulfills its highest level of satisfaction. The respondents were asked to repeatedly choose from changing combinations of characteristics of aspects that formed imaginary office workplaces. The aspects that were included in the experiment were derived from an extensive literature study that was executed to investigate which office workplace aspects influence the health of office workers with the precondition that they can be influenced by the landlord. This resulted in seven aspects (i.e. attributes) that are taken into account, being (1) 'indoor air quality', (2) 'thermal comfort', (3) 'exposure to light', (4) 'noise & acoustics', (5) 'office type', (6) 'view' and (7) 'provisions'. In addition, the aspect (8) 'rental price' was included in the experiment to derive tenants willingness to pay for the concerning office workplace aspects. All aspects were refined into seven attributes with three attribute levels each that follow ordinal qualitative scales which are respectively applied in a low, medium and high health quality office. The experiment was executed with an online survey that included the Stated Choice experiment as well as questions to identify the characteristics of the background of decision makers and their organizations of which included characteristics were determined by a literature study as well. The online survey is distributed among decision makers of office tenants of the CBRE Dutch Office Fund and was completed by 84 respondents.

Results

The data that was collected with the survey is analyzed by using two Discrete Choice models, being a Multinomial Logit model (MNL model) and a Latent Class model (LC model). The results of the MNL models apply to all respondents, while the results of the LC are divided into two segments that consist of respondents with comparable choice behavior. The MNL model fit indicates slight heterogeneity in the sample, but nonetheless, its estimates are appropriate to calculate the relative importance of attributes as well as to derive indications of preferences for office workplace characteristics. It became clear that 'thermal comfort', 'noise & acoustics' and 'provisions' are of relatively high importance among preferences for office workplace attributes, of which all attributes indicate higher preferences for healthier office workplace characteristics. The attributes 'office type', 'view' and 'indoor air quality' are slightly less important when making office workplace decisions of which the preferences for 'view' are indicated higher for healthier office workplace characteristics and the preferences for 'office type' and 'indoor air quality' relate a bit different. So is the medium health quality level of 'office type' preferred above the high health quality level and is the 'indoor air quality' only preferred on the high health quality level and disliked on the medium health quality. The 'exposure to light' was found to have no importance in office workplace decisions for the sample of this study, so no preference could be estimated for that aspect.

In the MNL model, the rental price is estimated to have dominant importance over all healthy office workplace aspects. This means that the price is considered the most when making office workplace decisions that include healthy office workplace aspects. With the preference estimates of the rental price, the willingness to pay (WTP) for all healthy office workplace aspects is determined. Although the preference estimates indicate that higher rental prices are disliked, a positive WTP for higher rents is determined for all healthy office workplace aspects except exposure to light. It found that the WTP for almost all aspects is the highest when improving from a low to a high health quality office and lower when making the improvement from a medium to a high health quality office. Only the WTP for the attribute 'indoor air quality' is higher when improving from a medium to high health quality office. Moreover, the WTP for 'office type' is negative when improving from a low to medium health quality office. When considering all significant healthy office workplace aspects as a whole, the WTP-range from a low to a medium health quality office is estimated at 6.37 – 12.33%, from a medium to a high health quality office at 6.17 – 12.43% and from a low to a high health quality office at 12.54 – 24.76%.

The LC model identified two market segments that both have different preferences regarding healthy office workplace aspects and WTP. Between both market segments, significant differences between organizational characteristics are identified to uncover what type of tenants the segments consist of. One segment has more preference for healthier levels of 'thermal comfort', 'noise & acoustics' and 'provisions' and consists of smaller tenants that lease in larger office buildings which are more operating at financial services, commercial services as well as trade and industry. In addition, that segment is more willing to pay for their preferred office workplace characteristics. The other market segment has more preference for healthier levels of 'light exposure', 'office type' and 'view' and leases more in smaller office buildings and consists of more larger tenants as well as organizations that operate in other (service) activities, including governmental and ICT organizations. This market segment is less willing to pay for the office workplace characteristics they prefer.

Discussion, Limitations & Recommendations

Like every research, the findings of this study are affected by limitations of which some provide recommendations for future research. The limitations of the literature study concern the identification of aspects and characteristics in the focus of this research. Those seem convenient but it is possible that aspects and characteristics are missing due to a lack of existing knowledge or are not found due to wrong research queries. Reflecting findings of this research with previous research indicate that former studies that also searched for effects of conjoint office workplace aspects show comparable sequences of trade-offs when filtering out the healthy office aspects that are included in this study, but those studies generally do not concern health or preferences of tenants as well as they are not conducted from the perspective the landlord. Furthermore, relating this research to (holistic) health in general is barely possible, because measuring health as a whole is difficult due to its dependency on a wide variety of circumstances of which this thesis only includes the influence of office buildings. Therefore, it is recommended for further research to investigate contributions of health outcomes due to office workplace characteristics to organizational performance to determine which office workplace characteristics really matter.

The internal validity, external validity, reliability and the limitations of the data analysis generally concern the extent of the sample, the focus of the sample and the possible complexity of the Stated Choice experiment. Moreover, it is debatable whether the respondents were representing their organization well as being the decision maker of office workplace accommodation. Also the chosen measure of the willingness to pay may have influenced respondents' choices and thus the outcomes of the models. Replication research in other

populations can take these limitations into consideration to conduct sharper analyses. In addition, recommendations for follow-up research are to identify the perspective of human resource managers as decision makers concerning healthy office workplaces and to create a business case to shift from beneficial investments to profitable investments for landlords. Also, when there is data available in the future when healthy office workplaces are implemented more frequently in practice, it is interesting to identify real-world decisions by mapping revealed choices so more external influences can be derived.

Implications

The findings of this research do mainly contribute to the insight of real estate investors, asset managers and developers because the findings implicate which healthy office aspects they can apply in their projects are the most beneficial to invest or innovate in. The results of this study guide them in which healthy office aspects must be given priority over others in order to add maximum investment value for future leasing or selling of their properties. In addition, the market segments that are distinguished can provide information when real estate investors, asset managers or developers are focusing on attracting or retaining specific tenants of which class preferences have been found. Furthermore, the preliminary research provides insights for tenants and property managers how to improve their workers' health by their office workplace, how that can enhance their organizational performance and how they have to collaborate with landlords to do that. In that context, the involvement of human resource departments of organizations can stimulate decision making about implementation of healthy office workplaces through raising awareness of the health outcomes on organizational performance.

1. INTRODUCTION

1.1 BACKGROUND

Organizations, both public and private, are highly dependent on their human capital. Labor costs in the Netherlands are over 370 billion euros in 2018 (CBS, 2019) and cover up to 90% of organizations' operating costs (Alker, Malance, Pottage, & O'Brien, 2014). This considerable share of costs indicates that it is important for organizations to utilize their human capital optimally. This especially concerns organizations that perform service work and knowledge-based activities, since their labor costs per hour are frequently higher than many other branches of industries. It is important for organizations to nurture their human capital because they can outperform their competitors with higher workplace productivity and sustaining high stocks of emotional and human capital (Boedker, Meagher, Vidgen, Cogin, & Mouritsen, 2017). To maintain the mental condition of their workers, companies increasingly acknowledge the preservation of health and wellbeing of their workers in their strategies. A study of Buck Consultants by Xerox Corporation (2014) among 428 employers in 33 countries assessed trends in employer-sponsored wellbeing strategies and practices to expand and include their future financial success. It reports that overall health and wellbeing are a global strategy among 69% of the employers and that wellbeing programs are expected to have impact on engagement (86%); organizational image (82%); overall wellbeing (78%); recruitment and retention (76%); and productivity (76%). In this study, stress is recognized as top health risks that drive these wellbeing programs in most areas of the world.

Despite such programs, mental health is a growing threat for society: 76% of the world's workers are struggling or suffering in their wellbeing (Yeung & Johnston, 2016). In The Netherlands, 42% of reports from occupational diseases are related to psychological complaints, of which 74% are diagnosed with overstrain and burnout symptoms (NCvB, 2018). Work-related omission due to psychosocial workload cost Dutch companies over €3.2 billion per year (TNO, 2019). Poor mental health of workers causes different kinds of reduced productivity that results in considerable costs for organizations (Bubonya, Cobb-Clark, & Wooden, 2017). Commonly, associations are made with particularly short-term mental disability to work, which is called absenteeism. But workers can also accomplish presenteeism which is caused by lower productivity while attending at work (Burton, Schultz, Chen, & Edington, 2008). Besides, a spillover effect on colleagues is likely to occur from workers that are absent by making another worker less productive (Dewa & McDaid, 2011). Also when an employee is absent, there can occur a "friction" period or a limited amount of time that a company takes to adjust to work disruptions related to a worker's disability (Koopmanschap & Van Ineveld, 1992). Additionally, burnout symptoms are linked with ill health (Melamed, Shirom, Toker, Berliner, & Shapira, 2006) and past mental and physical health show cross-effects to their future states (Ohrnberger, Fichera, & Sutton, 2017).

In the Netherlands, almost 40% of the workforce work in an office environment (Ecofys & Fraunhofer IBP, 2018). The design of the office workplace has proven to influence workers' job satisfaction, cognitive workload and interpersonal relations such as communication and feeling of privacy (De Croon, Sluiter, Kuijer, & Frings-Dresen, 2005) and health, wellbeing, and job satisfaction are correlated with office type (Danielsson & Bodin, 2008). Furthermore, the indoor climate including air quality, thermal comfort, lighting and noise are associated with the performance and wellbeing of office occupants (Alker, Malance, Pottage, & O'Brien, 2014). Also, exercise is linked to wellbeing: Lower physical activity levels at the office were related to higher mental stress levels outside the office (Lindberg, et al., 2018).

Physical symptoms due to unhealthy buildings have been reported in several studies as well, with increasing frequency since the 1970s, defined as the presence of the Sick building syndrome (Redlich, Sparer, & Cullen, 1997). It can be expounded by lacking quality of the building indoor environment or its services due to for example a buildings' occupancy above its design occupancy or inadequate performance and maintenance of climate systems (Stolwijk, 1991). Although the symptoms can not specifically be explained by their direct causes, the experiences of acute health- or comfort-related effects are common among occupants of buildings (Joshi, 2008). Symptoms can be divided into problems with the mucous membrane of the eyes, nose, and throat; a dry skin; headache and fatigue (Burge, 2004). The sick building syndrome must not be confused with building-related sickness, which happens when sickness is spread in buildings coming from co-users that are already sick.

Investments in building aspects that support the health and wellbeing of the workers who occupy them are difficult to allocate to their specific financial outcomes, particularly due to the complexity to measure productivity. Because traditional measures that calculate with units of production are not suitable for knowledge-based business, the 'holy grail' of measuring knowledge productivity seems intangible (Mawson, 2014). Also benefits from building-related performances are hard to measure and monetize (Birkenfeld, Brown,

Kresse, Sullivan, & Thiam, 2011). However, a present study from America based on 60 robust research studies provided a business-case for High Performance Buildings (HPBs) including calculations of the gains per employee and per square foot. HPBs are seen as buildings that draw optimal connections between employees and their working space. The results of the analysis suggest that the combined benefits due to occupant productivity, retention, and wellness can gain up to €249 per square meter office space in annual profit or €2,987 per employee (Attema, Fowell, Macko, & Neilson, 2018). If the study includes savings for utility and maintenance, these financial values will rise more. Financial benefits of health and wellbeing investments can be reached by for instance following the WELL Building Standard, with limited risks or execution (Muldavin, Miers, & McMackin, 2017).

1.2 PROBLEM OUTLINE AND STATEMENT

Problem outline

Past research has regularly been conducted from the perspective of end-users of office buildings. Several building aspects that could advance mental health and wellbeing have been mapped and tested on their individual applicability (Al Horr, et al., 2016) (Boerstra & Van Dijken, 2015). In addition, some studies tried to monetize them in terms of profits from the productivity and sustainability of human capital (Attema, Fowell, Macko, & Neilson, 2018) (Muldavin, Miers, & McMackin, 2017). With this knowledge, decision makers of business accommodation may be triggered to spend on higher health and wellbeing performance of buildings. However, no research has been executed from the perspective of these decision makers. It is essential for the implementation of healthy office workplaces to know which aspects tenants of office buildings, especially the people that decide about the organization's expenses are for accommodation, find relevant and in which magnitude. Without this insight, the supply-side of the real estate sector may act restrained with investing in healthy office amenities because they have no acknowledgment of whether the demand side is willing to pay for them.

Problem statement

The lack of insight on whether office tenants are aware of healthy workplace developments and whether they are willing to pay for implementation of specific aspects of healthy office environments, makes it difficult for real estate developers, investment- and asset managers to determine which healthy workplace aspects are beneficial to invest in. The following problem statement presents this observation:

> *Investments made by landlords in healthy office workplaces could be cost-inefficient as long as there is no evidence of the practical acceptance and willingness to pay by tenants that decide on the implementation of particular health aspects in offices.*

1.3 SCOPE

This research is focused on the *Dutch office market*. As one of the mature markets in Europe, the Dutch office stock is estimated over approximately 54 million square meters. The market is characterized by significant locational differences with a high density of offices across relatively short distances spread across the country (IVBN & JLL, 2017).

Because there is a broad diversity in the typology of offices in different areas of the Netherlands, the scope of this research is expected to be too wide for data collection about preferences of all different tenants that accommodate them. To narrow the scope, it is chosen to focus on *multi-tenant business centers,* which are in practice often called multi-tenant offices, on *prime office locations*. These are located in the most promising regions in The Netherlands that are called the G4 cities (Amsterdam, Rotterdam, The Hague and Utrecht) which cover 33% of the domestic office stock of the Netherlands. These locations attract tenants that generally lease office space that is more expensive per square meter and of higher building quality (IVBN & JLL, 2017) and thus have these tenants probably more financial capital to spend. Within the G4 cities, the locations containing several multifunctional hotspots that provide the best risk-return outlooks are selected. This scope is in line with the strategy of the CBRE Dutch Office Fund (DOF) which is an investment fund managed by CBRE Global Investors, the organization with whom this research has been conducted in collaboration.

In order to investigate the preferences of office tenants, quantitative data is collected among *decision makers* who determine what a company's expenses are for accommodation of their employees who perform service work and knowledge-based activities. In the scope of this research, decision makers are people who are in charge of the decision making process of organizations or directly influence the decision making process itself. To understand their preferences, the aspects that influence organizational decision making for office workplace accommodation such as the type of organization or the state of the current office are identified in this study.

1.4   RESEARCH OBJECTIVE AND QUESTIONS

Research objective

The interconnection of the problem outline and problem statement results in this following research objective:

The objective of this research is to identify which healthy office workplace aspects are beneficial to invest in by landlords through investigating preferences of tenants regarding trade-offs between particular aspects.

Research questions

To conduct the research, the main research question is defined as follows:

Which healthy office workplace aspects that are relevant for landlords are preferred by office tenants and how much are they willing to pay for the implementation of particular aspects?

In order to answer the main question, sub questions are composed. These sub questions are:
1 – What is the healthy office workplace and which aspects can be influenced by landlords?
2 – What are the aspects that influence organizational decision making for office workplace accommodation?
3 – What are the preferences of office tenants for particular health aspects in offices?
4 – How much are office tenants willing to pay for particular health aspects in offices?
5 – Which market segments of office tenants can be distinguished with regard to preferences and willingness to pay for particular health aspects in offices?

1.5   RESEARCH APPROACH

This thesis is divided into three research phases of which approach is provided in figure 1. The first phase is the descriptive research that includes the preliminary research. Subsequently, the explorative research is comprised in the second phase, covering the design and execution of the quantitative data gathering. The last phase describes the results from the data analyses and outlines the conclusion, limitations and implications.

The information of the preliminary research from phase 1 is gathered by reviewing existing literature and having conversations with professionals from the real estate sector. One aim of this phase is to provide an extensive definition of the healthy office workplace to derive healthy office workplace aspects and its characteristics. In addition, phase 1 aims to identify aspects that influence the decision making of tenants about office workplace accommodation in general.

The explorative research from phase 2 consist of design and execution of the quantitative research with the aim to find tenants' preferences regarding trade-offs between healthy office workplace aspects and its related willingness to pay. The design of the research is discussed by the underlying theory of *discrete choice modeling*. By performing a survey questionnaire among tenants containing a *stated choice experiment*, useful data is gathered.

In phase 3, the data from the survey questionnaire is analyzed and described in evident results with the use of a Multinomial Logit model, a Latent Class model and calculations of willingness to pay. To draw conclusions, the results are used to answer the main research question. Furthermore, the research is discussed and judged with limitations as well as supplemented with recommendations for future research. Last, research implications are set up.

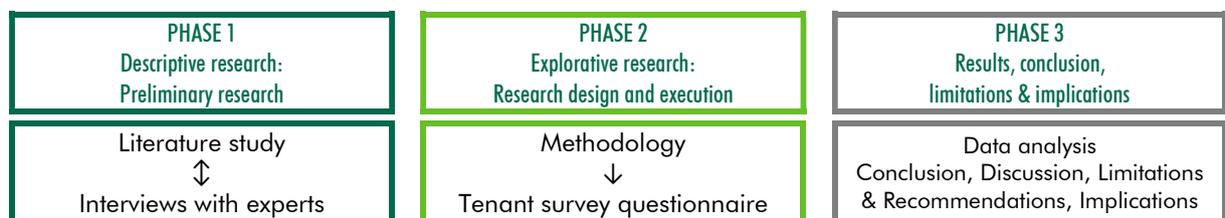| PHASE 1 Descriptive research: Preliminary research	PHASE 2 Explorative research: Research design and execution	PHASE 3 Results, conclusion, limitations & implications
Literature study ↕ Interviews with experts	Methodology ↓ Tenant survey questionnaire	Data analysis Conclusion, Discussion, Limitations & Recommendations, Implications

Figure 1. Research approach.

1.6 RELEVANCE

Societal relevance

This research framework faces the challenge of deteriorated societal health by facilitating workers' wellbeing though increasing their working conditions. On the one hand, wellness and work are interdependent through generating a vicious circle of making workers unmotivated, disengaged and unproductive which results in mental and emotional distress that can be linked directly to chronic diseases. On the other hand, wellness and work can create a virtuous circle of healthy and balanced feelings that result in motivation, satisfaction and productivity. In turn, because the workplace is social, it can support workers to develop healthy habits that also apply outside work (Yeung & Johnston, 2016).

Practical relevance

From the angle of the real estate market, this thesis is primarily of landlords' interest since this study is executed from their point of view. Investments in healthy office workplaces by landlords such as asset managers and real estate investors could preserve financial performance through attracting or retaining tenants. Furthermore, landlords can increase the value of assets because of the indicated growing interest among companies in this subject. Consequently, insights from this research can be encouraging for commercial real estate developers to incorporate health and wellbeing in (re)development concepts. Moreover, it can validate what specific healthy office aspects they should focus to innovate in.

In general, the relevance of this thesis counts for almost all organizations that are dependent on their human capital. It guides them to accomplish better business-economic results by justifying workplace expenses on profound decisions to use their human capital more efficient. Moreover, the understanding of financial decision makers can increase through considering healthier employees as workplace benefits and so be preferred above workplace costs. In that context, this study could encourage them to pay higher rents to strive for better business results.

Academic relevance

Overall health and wellbeing at work are of growing interest and become an important strategy for many employers to impact on engagement, organizational image, overall wellbeing, recruitment and retention and productivity of employees (Buck Consultants/Xerox Corporation, 2014). Past scientific evidence about health and wellbeing benefits in the physical office environment is focused on workplace aspects that favor office workers (Allen, et al., 2016) (Clements-Croome, 2015). Nonetheless, there is a lack of insight into the perspective of tenants and decision makers about organizations' real estate. This applied research is distinctive by filling the research gap between the existent scientific evidence of single workplace aspects that encourage workers' health and wellbeing by complementing those with the willingness to implement these aspects. It identifies the preferences of the decision makers about organizations' office workplace accommodation that are important stakeholders in the realization of healthy work conditions and sustainable employability. In addition, the results of this research present a trade-off between different variables that indicate a relative preference for certain workplace aspects from the view of office tenants. A ranked-list of particular aspects is valuable for researchers to focus on in future research. On the one hand to give priority to the most favored, on the other hand, to foster less preferred aspects.

1.7 INVOLVED COMPANY

This thesis will be completed in collaboration with CBRE Global Investors, a real asset investment manager. This organization creates various investment solutions for its clients in the field of real estate and infrastructure in the Americas, Europe and Asia Pacific. One of the funds CBRE Global Investors manages in The Netherlands is the Dutch Office Fund (DOF). This fund creates value through active management and core+ investment strategies, targeting on sustainable and consisting performance. The fund has a strategic focus on full-service multi-tenant office concepts on dynamic locations in the G4 cities of The Netherlands. Within their strategy, DOF fosters health and wellbeing in their buildings through certifying buildings with the WELL Building Standard and increase overall WELL-scores.

1.8 RESEARCH STRUCTURE

After this chapter, the first part of the preliminary research will follow wherein the understanding of the healthy office workplace with an exploration of its aspects and its characteristics is described in chapter 2. Subsequently, the characteristics of tenants of multi-tenant business centers that influence decision making of office workplace accommodation are identified in the second part of the preliminary research in chapter 3. In chapter 4, the methodology that is applied in this research is outlined. In chapter 5, the collected data that is generated is derived into appropriate results. Al last, the conclusion, discussion, limitations, recommendations and implications of the whole research are given in chapter 6.

2. HEALTHY OFFICE WORKPLACES

The office workplace has changed under different circumstances through time. Former research and experiences developed the understanding that workplace aspects influence the physical health of office workers. Subsequent insights also consider the influence of the office workplace on the mental health of workers along with attention to consider wellbeing as well as a part of people's state of health. The comprehensive research field that involves the influence of office workplace aspects on health is covered with the term of the healthy office workplace.

The purpose of this chapter is to outline the understanding of the healthy office workplace. First, the emergence and the definition of the healthy office workplace are emphasized. Subsequently, the elements of healthy office workplaces are classified into aspects that are addressed in this thesis. The aspects are further discussed by characteristics that are found in the existing literature that fit the scope of this thesis. This chapter finishes with a conclusion that answers research sub question 1 of this thesis: *What is the healthy office workplace and which aspects can be influenced by landlords?*

2.1   THE EMERGENCE OF THE HEALTHY OFFICE WORKPLACE

At the beginning of the Industrial Revolution, there were no concerns about health and wellbeing in the workplace. Around 1900, the first governmental regulations emerged to prevent a worker from unsafe or unhealthy work circumstances but were particularly focused on factory workers (Danna & Griffin, 1999). The theory of scientific management by Frederick Winslow Taylor influenced industries through rationalization of production processes to improve efficiency. The standardized consecutive actions of workers in factories also influenced office environments since office work mainly consisted of repetitive administrative operations (Haynes, 2007a). In the period after the Second World War, Western organizations were shifting from manufacturing-based operations in factories to a more service and knowledge-driven business in offices and thus drove demand for more and larger offices. Although the economy was shifting, scientific management was still being applied in office environments by spatial arrangements that reflected hierarchies in terms of use of time and social status. Ongoing developments of heightened mobility, changing consumer behavior, deregulation and more flexible labor processes resulted even more into migration to a service and knowledge economy (Laing, 1991). Although the scale of office work was increasing, the attention to health and wellbeing in office workplaces was lacking. From the 1980s, office buildings were transforming even more due to organizational changes linked with the development of information technology which also affected the place of work itself. New communication technologies decreased the need for transport between offices and linked individuals and groups at a distance so they could perform work tasks across places instead of being present in the same location. Furthermore, organizations had to streamline their office workplaces by shrinking in size and relocating staff, space and facilities in response to recessions. In that same period, the Sick Buildings Syndrome (SBS) was indicated by the World Health Organization (WHO) and recognized by several studies (Redlich, Sparer, & Cullen, 1997). Later studies found a considerable decrease of SBS symptoms when a building is ventilated properly. Moreover, workers that experienced asthma, high job strain, low social support at work and excessively long working hours with electronic displays have been associated with increased prevalence of SBS (Bourbeau, Brisson, & Allaire, 1996). Also, musculoskeletal disorders of neck, shoulders and lower back due to low job variation, long driving distances and sedentary work became related to physical factors (Skov, Borg, & Orhede, 1996) that called for ergonomic solutions and workplace redesign.

In 1991, John Elkington reported about the business of the 21st century by commencing a new way of thinking that enhances the modern approach of health in the office workplace. Elkington argued that social justice, environmental quality and economic prosperity are the three interrelated key elements of organizations' performance that will be measured to gain success (Elkington & Rowlands, 1999). This concept is called the Triple Bottom Line (TBL) and is recognized with People, Planet and Profit as three components of corporate responsibility (Van Marrewijk, 2003). The TBL-model ensures that giving attention to one component, the other components will benefit as well and vice versa. Likewise, if one component is deficient, the others will be disadvantaged as well. The People component affects the healthy office environment in the management culture of people of all involved stakeholders, the workplace environment, safety and health, diversity, work ethics and influence of globalization, consumers and suppliers (Van Marrewijk & Werre, 2003). The consciousness within organizations to invest in human capital had to become compatible with the insight that the workplace needs to support the performances of workers optimally to achieve the most effective level all the time (Mawson, 2002). Traditionally, the office environment is considered as the physical environment including the components office layout and comfort assuming workers as passive elements. Nonetheless, the behavioral environment is integral with office productivity concerning the components of interaction and

distraction (Haynes, 2007a). In that mindset, the way of thinking about the productivity of office environments should be shifted from a control paradigm to an enabling paradigm, meaning that controlling the productivity of the environment with reduction in space and costs of resources can better be approached with providing an environment that enables increase of productivity of employees (Haynes, 2007b). Organizations are challenged to find the optimum balance between the need of individuals and the need of the organization since the key asset for most organizations is their people. Therefore, organizations should provide work environments that enable workers to perform on their most effective level while keeping the cost of providing that work environment in balance (Oseland, 2009). To pursue the performance optimization of people, occupational health levels must be fostered (Kirsten, 2010). Besides physical health, also mental health (Burton, Schultz, Chen, & Edington, 2008) and wellbeing (Harter, Schmidt, & Keyes, 2003) are very important to consider, especially since the nature of work has changed from a passive and static activity to a dynamic and flexible activity that requires other office environments nowadays. Moreover, physical health, mental health and wellbeing are interrelated (Goodwin, 2003) (Melamed, Shirom, Toker, Berliner, & Shapira, 2006) as well as social relationships and social support to improve physical health and mental health (Thoits, 2011).

2.2   HEALTHY OFFICE WORKPLACE OUTCOMES

In general, health in work environments concerns providing safety to workers by preventing accidental injuries. When a worker suffers from an injury at work, direct and indirect costs have to be made by the employer. Depending on the country, health care costs, insurance costs, legal costs, equipment damages, direct and indirect production interruptions have negative outcomes for the performance of the organization (Burton, 2010). Nonetheless, within office buildings, these risks are generally lower than in workplaces where physical work is operated. The state of office workers' health has long been considered as a productivity measure of workers in terms of absenteeism, meaning absence for scheduled work. The interest in presenteeism is relatively new and concerns the diminished performance of workers while they are attending work (Bubonya, Cobb-Clark, & Wooden, 2017). The majority of studies show that especially decrease in mental health influences absenteeism and presenteeism (Burton, Schultz, Chen, & Edington, 2008). Moreover, absenteeism and presenteeism have a spillover effect on colleagues by making them less productive or lowering their output quality (Dewa & McDaid, 2011) due to potential losses during 'friction' periods where colleagues have to adjust to work disruptions (Koopmanschap & Van Ineveld, 1992). In an adverse scenario, it is needed to recruit and train a replacement worker (Burton J. , 2010).

Practicing a healthy workplace result in positive outcomes of workers through increases in organizational commitment, job satisfaction, employee morale and motivation as well as decreases in job stress and physical health risks (Grawitch, Gottschalk, & Munz, 2006). In turn, workers' health outcomes improve the organizational outcomes by productivity, organizational effectiveness, competitive advantages, product/service quality and hiring selectivity along with decreases in absenteeism, turnover, health care costs, accidents and injury rates (Grawitch, Gottschalk, & Munz, 2006) (Harter, Schmidt, & Keyes, 2003). Moreover, organizations can benefit from positive outcomes of attracting and retaining talent. By improving their brand and corporate social responsibility (CSR) through attention for healthy workplaces, they can gain a competitive position in the war for talent (Allen, Bryant, & Vardaman, 2010). Satisfaction with healthy workplace practices is of importance to achieve the desired worker outcomes (Grawitch, Trares, & Kohler, 2007).

Besides positive outcomes that favor building occupants and tenants, the owners of buildings could also benefit from healthy workplaces by better returns on investments. A survey among American and Canadian building owners found that respectively 35% and 46% expect the ability to lease buildings more quickly, respectively 22% and 28% expect that they are able to charge premium rent and respectively 26% and 30% think that healthy building investments impact on the value of the building with an average of 2.5% (Jones & Laquidara-Carr, 2016). However, the results of both surveys show that nearly half of the building owners do not know the impacts of healthy building investments which deems to be true since there are not that many cases in practice. Furthermore, a slower depreciation of property values may be expected when the present value of future replacement costs is lower than non-healthy buildings, because healthy buildings may retain more attractive to tenants and therefore do not need replacement investments. Yoshida and Sugiura (2015) illustrated a similar effect for green buildings since higher future replacement costs could be discounted on the potential transaction price.

2.3   DEFINITION OF THE HEALTHY OFFICE WORKPLACE

Before proposing a definition of the healthy office workplace, this research intends to provide a conceptualization of the terminology of health and wellbeing since these terms are the fundaments of this thesis. The definition of health from the WHO in 1946 is: "Health is a state of complete physical, mental and social well-being and not merely the absence of disease or infirmity" (World Health Organization, 2014). This

definition is criticized by Huber et al (2011) on three factors. First, the word 'complete' does not include a threshold related to wellbeing and it suggests that people are unhealthy most of the time. Second, chronic diseases are left out of consideration in a way it does not imply the human capacity to cope with changes in health challenges. Third, the definition refers to a complete state and is therefore impracticable for operationalization. To meet this criticism, a new proposed formulation of health is the ability to adapt and self manage in the face of social, physical, and emotional challenges (Huber, et al., 2011). In this study, health is identified in three domains: physical, mental and social health, wherein the physical domain is seen as the physiological homeostasis, the mental domain as the sense of coherence in complicated situations and the social domain as fulfillment, management and participation of social activities (Huber, et al., 2011).

Physical health is about a human body's capacity to protect from harm outside the body as pain, illness and diseases as well as to adapt such harm on or inside the body by reducing and restoring it (McEwen, 2003). Moreover, it is about "the maintenance of the physiological homeostasis through changing circumstances" (Schulkin, 2004) which is called allostasis. Physical health is dependent on several factors as physical activity, nutrition, drugs, self-care, rest and sleep (Belloc & Breslow, 1972).

Mental health is not only the absence of mental illness, but also positive mental health needs to be taken into account which complies with wellbeing (Westerhof & Keyes, 2010). The review of Clements-Croome (2015) also argues that wellbeing is part of mental health and that it is "connected with overall satisfaction, happiness and quality of life and is thus a much more encompassing word than comfort reflecting a more complex multi-dimensional concept" (Clements-Croome, 2015). This agrees with a multi-disciplinary review of Dodge et al (2012) about dimensions of wellbeing that approached wellbeing with a new definition. The study relates wellbeing to the "the balance point between an individual's resource pool and the challenges faced" (Dodge, Daly, Huyton, & Sanders, 2012). The JD-R Model of Schaufeli & Taris (2014) conceptualizes that with the relations between workers' health impairment (job demands, strain, health problems) and workers' motivation (job resources, well-being, performance). Besides wellbeing, the inconsistency about the use of the word 'stress' must be clarified. Stress is not a health domain but an impact on health because it is examined by a wide range of issues of which links have been found with coronary heart disease, mental breakdown, poor health behaviors, job satisfaction, accidents, family problems, certain forms of cancer and premature deaths (Cooper & Cartwright, 1994). Stress in the workplace is determined by the proportion of challenges. An overload of challenges is called strain and a shortage of challenge causes boredom (Edwards, Caplan, & Van Harrison, 1998) which both influence the mental health. Another confusion deals with the word 'comfort', which also impacts health. Psychological comfort relates to biological responses and body dimensions, functional comfort refers to suitability of work environments for work tasks and psychological comfort concerns individual and interpersonal space-related needs (Feige, Wallbaum, Janser, & Windlinger, 2013).

Social health relates to feelings of belonging and social inclusion. It is about the ability to participate and adjust in social situations and is dependent on communication with other human beings (McDowell, 2006, p. 150). It concern how an individual gets along with other people, how others react that individual and how the individual interacts with social institutions and societal mores" (Russell, 1973) and so incorporates personality, sociability and social skills. Moreover, it is about the social support of people that an individual can rely on (McDowell, 2006, p. 152).

Organizational health is interdependent with individual health and includes four basic principles according to Adkins et al (2000). The first principle is that the range of health is between positive wellbeing and mortality. The second principle is to consider health as a process, not a state. Principle three concerns the interrelations of our health system, implying that if one part suffers, the whole system is vulnerable. The last principle concentrates on communication, collaboration and relationship-building to identify weakened health in advance (Adkins, Quick, & Moe, 2000). In addition, programs and policies are needed to guide all the principles. Health in the workplace can be approached from different angles of influencing workers. From an organizations' perspective, the healthy office workplace "maximizes the integration of worker goals for wellbeing and company objectives for profitability and productivity" (Sauter, Lim, & Murphy, 1996).

The World Health Organization (WHO) states another broad definition of the healthy workplace: "A healthy workplace is one in which workers and managers collaborate to use a continual improvement process to protect and promote the health, safety and well-being of all workers and the sustainability of the workplace by considering the following, based on identified needs:

- Health and safety concerns in the physical work environment;
- Health, safety and well-being concerns in the psychosocial work environment including organization of work and workplace culture;
- Personal health resources in the workplace;
- Ways of participating in the community to improve the health of workers, their families and other members of the community" (Burton J. , 2010).

The definitions that are mentioned in this paragraph differ in subject matter and extent. To drive towards a definition that will be adopted in this research, the elements of the given definitions that fit the scope of this thesis are converted to a new definition. The health component of the new definition will be used conform the interpretations of Huber et al (2011), Dodge et al (2012) and Adkins et al (2000) as a combination of physical health, mental health and social health. Within these health components, safety is part of preserving physical health, feelings of safety are part of preserving mental health, wellbeing, comfort and satisfaction will be interpreted as positive mental health and stress as negative mental health. The organizational component of the new definition will be used as the goal to maximize workers' performance based on the interpretations of Sauter, Lim & Murphy (1996). The definition of the WHO is adding the workplace component to the new definition that complies with this study's interpretation of health and includes aspects that protect and promote the health of workers. Furthermore, the definition is stated as one that can be used by all stakeholders that can influence office workplace health in general. The new definition is:

> *A healthy office workplace is the optimum alignment of the totality of workplace aspects that protect and promote physical health, mental health and social health of the workers inside the office with the purpose to maximize the performance of the organization's human capital.*

2.4   CLASSIFICATION PRINCIPLES
To fit the scope of this research, a classification of healthy office workplace aspects is made on certain principles. First, all aspects have to influence the physical health, mental health or social health of office workers. Second, all aspects must apply to office buildings. This means that research that has been conducted concerning other amenities as schools or hospitals is excluded. Third, it is important that healthy office workplace aspects are selected that can be influenced by the landlord and thus are not specific for a tenant or the occupants of an office building. This means that workplace aspects that relate to the building but are implemented by tenants or occupants in their leased space do not comply with the classifications principles, for instance ergonomic chars. That also means for organizational culture aspects of tenants such as programs to advocate health.

2.5   SELECTION OF HEALTHY OFFICE WORKPLACE ASPECTS
This paragraph describes the selection of the healthy office workplace aspects according to the available literature that has been found which follow the classification principles. First, the studies that provide overviews of health aspects in office workplaces are considered to obtain a total view of aspects. Subsequently, the healthy office workplace aspects that are relevant for this research are selected and converted into final healthy office workplace aspects. This conversion also treats comparable terminology between studies. Then, it is explained why (parts of) aspects are left out of consideration in this study.

A substantial part of research consider health in office workplaces as aspects of building physics that determine the indoor environmental quality (IEQ) (Bluyssen, 2009) (Huang, Zhu, Ouyang, & Cao, 2012) (Feige, Wallbaum, Janser, & Windlinger, 2013) (Lamb & Kwok, 2016) (Al Horr, et al., 2016) (Allen, et al., 2015). Building physics is an applied science that studies the hygrothermal, acoustic and visual performance of buildings (Hens, 2012). In most IEQ literature, these physics are expressed in qualities of air, humidity, heat, light and sound, whereas humidity is part of the air quality since it is the physical quantity of the concentration of water vapor in the air.

In addition to research that considers IEQ aspects, other studies take more office workplace aspects into account. These studies also advocate spatial and aesthetic elements of the office design in relation to health and wellbeing in offices as well as provided services in proximity of the office location. De Croon et al (2005) found evidence that workplace type and layout as well as acoustic and visual stimuli all influence office worker wellbeing. Literature research from Singh et al (2010), Clements-Croome (2015), Allen et al (2016), Lee & Clements-Croome (2019); reports from The World Green Building Council (WorldGBC) and STOK company; and an experiment of CBRE provide comprehensive and substantial overviews of different elements of a healthy office. Singh et al (2010) defined seven office building aspects that impact health; Clements-Croome (2015) described a healthy office environment with nine characteristics; Allen et al (2016) outlined nine foundations of healthy buildings; the WorldGBC suggested eight elements that comply with the physical office workplace (Alker, Malance, Pottage, & O'Brien, 2014) (Ambrose, Powell, Laski, & Lajeunesse, 2016); the multidisciplinary experiment of CBRE applied different interventions in an in-use office environment and found five elements that impact worker health (CBRE, 2017); and STOK mentioned six design strategies that foster inter alia health (Attema J. , Fowell, Macko, & Neilson, 2018). Lee & Clements-Croome (2019) have attempted to build a framework to understand the impact of health interventions in the workplace through a comprehensive health model in seven dimensions. Although the studies all tend to present the total of healthy office workplace aspects, their extent, content and terminology thus differ.

In practice, the WELL Building Standard is repeatedly used as a measure of healthy workplace aspects. The Standard was launched in 2014 and is increasingly used as certification for buildings that focus on the health and wellbeing of the building occupants and mainly focusses on offices (IWBI, 2018). The second version of the WELL Building Standard includes features that can be fulfilled to meet a certain level of certification. These features are expressed in elements of air quality (Air), water quality (Water), food (Nourishment), lighting (Light), ergonomics, exercise, activity (Movement), thermal comfort (Thermal Comfort), acoustical comfort (Sound), quality of materials, aesthetics (Materials), mental health (Mind) equality, social cohesion and engagement (Community) (IWBI, 2019). In general, the WELL Building Standard corresponds with the scope of this thesis since it focusses on health outcomes in office workplaces. Nonetheless, a part of the features does not concern the scope of this research because they are influenced by the organization behind the tenants or occupants instead of the landlords of buildings. Moreover, the scientific evidence behind the features is not completely consistent with office workplaces. For instance, some research is conducted in educational or medical environments and thus are not comparable with office environments (IWBI, 2018).

Across the relevant aspects that are suggested in the literature, another element has been found that influences the health and especially wellbeing in offices. This element concerns the personal control of occupants over workplace preferences, particularly of IEQ and spatial elements (Huizenga, Abbaszadeh, Zagreus, & Arens, 2006) (Galasiu & Veitch, 2006) (Lee & Brand, 2005). Although landlords cannot influence individual preferences, they can provide the ability in their properties to enable occupants to adapt their workplaces with personal settings. For instance, landlords can applicate a flexible building layout grid that enables to reshape office units, where installation controls of IEQ can be adjusted per unit. In this research, personal control is not approached as an individual aspect, but as part of most of the other aspects.

In order to clarify how the different characteristics of the different studies are converted into final aspects, an overview is presented in table 1. The table shows which workplace characteristics that are mentioned by existing literature partially overlap in their coverage of the scope of this research. The left column includes the final aspects in bold text, while the right columns reflect the comparable terminology of how it is used in the studies.

There are a total of seven final aspects selected that fit the focus of this thesis. The IEQ elements are converted into (1) Indoor Air Quality, (2) Thermal Comfort, (3) Light Exposure and (4) Noise & Acoustics. Spatial and aesthetic elements of the office design are converted into (5) Office Type and (6) Views. Services inside multi-tenant business centers are turned into (7) Provisions.

Table 1. Healthy office workplace aspects conversion

Aspects	De Croon et al (2005)	Vischer (2007)	Singh et al (2010)	Alker et al (2014)	Clements-Croome (2015)	Allen et al (2016)	Ambrose et al (2016)	CBRE (2017)	Attema et al (2018)	IWBI (2018)	Lee (2019)	Comparable thermology
Indoor Air Quality	x		x	x	x	x	x		x	x	x	Ventilation, dampness
Thermal Comfort	x	x	x	x	x	x	x		x	x	x	Temperature
Light Exposure	x	x	x	x	x	x	x	x	x	x	x	(Day)lighting
Noise & Acoustics	x	x	x	x	x	x	x		x	x	x	Acoustic comfort, distraction, annoyance, sound
Office Type	x	x		x	x		x		x		x	Office layout, spatial organization/settings
View			x	x	x		x		x	x	x	Visual access, landscaped surroundings
Provisions				x			x		x			Access to amenities
Active design			x				x	x		x	x	Physical exercise, Fitness
Biophilia			x				x	x		x	x	Natural space, greenery
Nutrition								x		x	x	Nourishment
Ergonomics	x	x		x	x	x				x	x	Furniture quality, ergonomic design
Color & Material use	x	x	x				x			x	x	Look & feel, architectonic details, ambiance, aesthetics
Mind(fulness)								x		x	x	Mental balance, self-fulfillment
Cleanliness						x				x	x	Dusts and pests, cleaning protocol
Water Quality						x			x	x		-
Safety & Security						x			x	x		-

Although all identified aspects in table 1 do influence the physical health, mental health or social health of office workers as well as they are applicable in office buildings, some aspects have constraints regarding the influence of the landlord or can partly be interpreted in another aspect. The rows of the left column with light green text in table 1 do partly belong to another aspect. The bottom rows of the left column with grey text in table 1 include the aspects that are left out of consideration according to the classification principles of paragraph 2.4. Active design is partly left out of consideration since in literature it is mostly described in programs that promote physical exercise or furniture that encourage to sit less. Sports facilities inside office buildings are part of the provisions aspect. Biophilia outside the office belongs to the aspects view, while biophilia inside the office is part of the furniture and thus both are not relevant to form a separate aspect. Nutrition can partly be influenced by landlords in facilities that provide healthy nutrition options. Therefore, this aspect is partly considered in the provisions aspect. Nutrition as part of health programs of organizations that lease office space cannot be influenced by the landlord and thus does not fit the scope of this research. Mind(fulness) is determined by organizational programs or culture and so cannot be influenced by the landlord. Color & Material use is mainly determined by the built-in characteristics of the leased space. Landlords do partly influence look & feel, architectonic details and ambiance in the rest of the office building. Nonetheless, the biggest influence of color & material use on workers' health is determined by tenants' leased space since workers spend there most of the time. Ergonomics are chosen by tenants' because they determine the features of their furniture in their leased space. Cleanliness is mostly not of influence because this is more in the field of property management and facility management, not investments by landlords. However a landlord that performs its own asset management can hire cleaning services, it is more of indirect influence. The water quality is discarded because it is obligatory by law in the Netherlands that tap water ensures the right quality of drinking water to consumers and other customers. In detail, it states that per volume unit or concentration it does not contain organisms, parasites or substances that can have adverse effects on public health (Drinkwaterwet, 2009, Hoofdstuk III, §1, artikel 21.1). However safety and security is part of preserving physical health and feelings of safety and security are considered as preserving mental health, both elements are left out of consideration since those are also basic principles by law (Bouwbesluit 2012) and not improving building quality comparing to office buildings with low health quality. Mindfulness and mind are discarded because a landlord cannot influence these elements.

2.6   HEALTHY OFFICE CHARACTERISTICS

The final healthy office workplace aspects are explained in more detail in the following subparagraphs. The final aspects have been further investigated by an in-depth literature study of which characteristics are described per aspect.

Indoor Air Quality

The indoor air quality (IAQ) in offices is influenced by multiple characteristics that have various health outcomes for workers. The IAQ is dependent on the ventilation rate, the composition of the air and its relative humidity. The ventilation rate is the amount of air that is changed from a space per time unit per person, expressed in liter per second (Ls^{-1}) per person. In general, higher ventilation rates influence the IAQ positively due to new inflow of air outside the space and outflow of 'used' air inside the space. Ventilation rates below 10 Ls^{-1} per person are associated with worse perceived IAQ and lower values of health outcomes, while ventilation rates above 10 Ls^{-1} per person up to approximately 20 Ls^{-1} per person are associated with improvements of perceived IAQ and decreases of prevalence of sick building syndrome symptoms (Seppänen, Fisk, & Mendell, 1999). Other studies reviews indicate increases of perceived IAQ and performance till ventilation rates of 45 Ls^{-1} per person (Wargocki, Wyon, Sundell, Clausen, & Fanger, 2000) (Seppänen, Fisk, & Lei, 2006). So, basically, the increase in the ventilation rate leads to an increase in health outcomes.

A requirement of the inflow of 'fresh' air is that it has better conditions than the outflow of air, otherwise the IAQ will not increase. 'Fresh' air one the one hand is dependent on conditions of carbon dioxide (CO_2) and volatile organic compounds (VOCs) (Park & Yoon, 2011). Increased ventilation rates generally improve the acceptability of perceived IAQ and work performance through decreases of these concentrations. CO_2 concentrations mainly come from human production and exhalation and VOCs are known to be emitted from for instance interiors' finishing as latex paints or from outside the building such as particulate matter. Exposure to both CO_2 and VOC concentrations influence human performance (Satish, et al., 2012). Especially cognitive function scores are proven to be significantly better in "green" office space with low concentrations of CO_2 and VOCs than in "conventional" office space with higher concentrations of CO_2 and VOCs (Allen, et al., 2016). VOCs are also associated with perceived IAQ, sensory irritation of eyes and upper airways and longer-term effects such as pulmonary and cardiovascular problems (Wolkoff, 2016). The intensity of odor is also an indicator of perceived freshness of air of people in a space, wherein undesired odors may negatively influence the mental health and pleasant odors may positively influence mental health due to higher comfort (Wargocki, Wyon, Sundell, Clausen, & Fanger, 2000). Thus keeping both CO_2 and VOC concentrations as well as

unfavored odors outside a space as well as removing those concentrations that are produced inside a space, maintains high levels of IAQ that lead to positive health outcomes.

'Fresh' air, on the other hand, is dependent on the relative humidity in a space. Relative humidity is the ratio of the partial pressure of water vapor at a certain temperature, expressed in percentages. The impact of relative humidity has a more negative impact on longer-term symptom development than on the immediate perceived IAQ (Wolkoff & Kjærgaard, 2007). Low relative humidity increases the development of dry eyes which causes deterioration of the precorneal tear film and visual display unit work. Under 30% relative humidity the eyes and skin become dry, while under 10% relative humidity also the nasal mucous membrane becomes dry and the mean skin temperature decreases (Sunwoo, Chou, Takeshita, Murakami, & Tochihara, 2006). Humidification of the air can alleviate dryness symptoms that are related to the SBS (Reinikainen & Jaakkola, 2001). High relative humidity, called dampness, increases the risk for the respiratory symptoms as cough, wheeze and asthma, but also unspecific symptoms such as tiredness, headaches and airway infections (Bornehag, et al., 2011). Hence, it is important to keep values of relative humidity in balance.

Besides physical health benefits, occupant satisfaction about air quality in office buildings is generally rather low (Huizenga, Abbaszadeh, Zagreus, & Arens, 2006) which has an effect on mental health. Increasing IAQ through higher ventilation rates and well-maintained composition of the air can ensure that. Therefore, building installations for air treatment and air filtering must be applied. Although these installations require higher costs for investment, maintenance and energy, worker' performance benefits due to health outcomes are considerable (MacNaughton, Pegues, Satish, Spengler, & Allen, 2015) (Bekö, Clausen, & Weschler, 2008), especially when considering that outdoor air is a source of indoor particles whenever there is no air treatment and filtration in mechanically ventilated buildings.

Thermal Comfort

Office workers' thermal comfort does impact on physical and mental health and is dependent on the temperature in the workplace. Thermal discomfort mainly expresses in a feeling of heat and cold. Both convection and radiation influence the operative temperature in a space that influences the satisfaction levels of the thermal environment that range per office worker (Huang, Zhu, Ouyang, & Cao, 2012). To reach overall thermal comfort in a workplace, the operative temperature must be in the satisfaction range of every office worker that is present in a space. When the operating temperature is too low for some office workers, they feel cold, vice versa they feel hot.

Especially warm thermal conditions can have negative effects on health and performance comparing to thermally neutral conditions. When office workers feel warm, multiple physiological mechanisms are affected in terms of increasements in heart rate, respiratory ventilation, and end-tidal partial pressure of carbon dioxide as well as decreases of arterial oxygen saturation and tear film quality. Higher indoor temperatures can also increase SBS symptoms regarding dryness of skin and upper airways. Moreover, feelings of warmth can result in result in less willing to exert effort, decreased task performance, more negative moods, more occurrence of sick building syndrome symptoms and worse assessments of the IAQ (Seppänen, Fisk, & Lei, 2006) (Lan, Wargocki, & Lian, 2011) (Reinikainen & Jaakkola, 2001). Higher temperatures also may increase odor intensity, stuffiness, sweat production, headache intensity, difficulties in thinking clearly, concentrating and irritation of eyes, nose and throat (Witterseh, Wyon, & Clausen, 2004). Cold thermal conditions have a mainly worse effect on health in terms of illness and injury when temperatures are very low (Parsons, 2014). In office environments this is less likely is cold confined with strains on the heart and respiratory system as well as low skin temperatures, particularly in hands and feet. That can result in workers' discomfort and distraction that may lead to loss in attention and breakdowns of disciplines.

The study of Huizenga et al (2006) shows that a minority of building occupants is generally satisfied with their thermal environment, but the satisfaction can be increased by providing personal control over the temperature with for instance a thermostat or an operable window. This personal control is dependent on the user controls, the heating and cooling system and the control strategy (Karjalainen & Koistinen, 2007). Furthermore, there are significant differences between genders about thermal comfort (Karjalainen, 2007). Females prefer significantly higher temperatures than males, the sensitivity of females of both hot and cold temperatures is higher than males and females experience uncomfortable feelings of cold or hot more often. Likewise, the satisfaction of females about room temperatures is lower than males and females are more critical in their thermal environment.

Light Exposure

Workers' exposure to light is dependent on the quantity and quality of both daylight entry and artificial lighting. In office workplaces, daylight is determined by the manner how workers are exposed to natural light from outside the office via windows. This is influenced by the orientation of windows, the window size, and the effects of window blinds. Moreover, the quantity and quality of daylight can differ per workstation since each workstation is positioned differently from to the daylight entry (Galasiu & Veitch, 2006). Artificial light is applied

inside the office and is often implemented for compensating daylight with quantity and quality of light color temperatures and illumination levels.

Elzeyadi (2011) found that workers use more sick leave hours in offices with poor daylight quality. That can be explained by the study of Boubekri et al (2014) that found that workers with no windows in their workplaces experience more physical problems, a negative impact on their vitality and lower mental health. Moreover, workers in office workplaces without windows perform more physical activity inside and outside the office during workdays and have more light exposure during spare time what both can cause spillover effects. In general, health is influenced by light through radiation, through the visual system or through the circadian system (Boyce, Hunter, & Howlett, 2003). Among them, radiation is not relevant in this study since negative health impacts due to radiation are generally caused by direct contact with daylight outside the office and are dramatically reduced inside the office by passing through glass. The presence of daylight is effecting the human visual system positively, but too much daylight causes glare and distraction by reflection and shadows (Boyce, Hunter, & Howlett, 2003) which both lower the difficulty to see in the presence of bright or dark light and so can cause eyestrain and migraine (Boyce, Hunter, & Howlett, 2003) or reduce office worker performance (Heschong, 2003). Daylight entry can be lowered by applicating window blinds, of which office workers are more satisfied when having personal control over it (Chraibi, et al., 2016) (Meerbeek, et al., 2014). In offices where electrochromic glass (EG) is used instead of traditional non-tinted low-e glass (LeG), workers report better daylight, less adverse glare and reduced prevalence of symptoms causing computer vision syndrome (CVS) as eyestrain and headache (Hedge & Nou, 2018). Less exposure to daylight, especially during winters, is found to have negative effect on people's circadian cycle that can result in poor sleep quality, lack of alertness, seasonal depression, immune deficiencies and may increase malignant tumor growth (Figueiro, Rea, Stevens, & Rea, 2003). In turn, poor sleep quality has various health consequences for leptin levels, endocrine functions and metabolism (Spiegel, et al., 2004) (Spiegel, Leproult, & Van Cauter, 1999). A lack of sleep quality also affects people's safety by increasing the chance of accidents (Leger, 1994) and can negatively influence productivity (Rosekind, et al., 2010).

Besides daylight, electrical artificial lighting has an important influence on office workers' health, especially when there is less daylight available. Artificial light can complement daylight by increasing illuminations on spots where too little daylight is available and correcting daylight brightness fluctuations due to weather changes. The illumination level affects the visual appeal of an office space of which a higher illumination level is preferred for impressions of brightness, spaciousness, comfort and saturation evaluation while a higher illumination level is preferred for relaxation (Manav, 2007). Furthermore, artificial light can increase the quality of the light which is dependent on the direction of the light, the light color and the absence of light flickering (Boerstra & Van Dijken, 2015). The color temperature differs per impression (Manav, 2007), but cool white and artificial daylight colors are more beneficial for computer-based tasks of office workers, while warm white light color increases alertness and is considered as most comfortable and preferred by office workers (Sivaji, Shopian, Nor, Chuan, & Bahri, 2013). Moreover, people prefer to be able to control the artificial light system (Manav, 2007).

Noise & Acoustics

Noise is caused by unfavorable sound that people hear and distracts them by doing their work in the office. This sound may come from meaningful background noise from sources inside the office such as understandable conversations as well as non-meaningful background noise from sources inside and outside the office such as building installations or traffic (Boerstra & Van Dijken, 2015). Distraction is suggested not to be determined by sound level but by the Speech Transmission Index (STI) which is a physical measurement method that is determined by the reverberation time of the room and the signal-to-noise ratio of speech. A lower STI means worse intelligibility of speech which has been proven to influence worker performance (Hongisto, 2005). Disruption of tasks in open-plan offices is related to speech and background sounds which influences the performance on memory for word processing and mental arrhythmic tasks (Banbury & Berry, 1998). Noise has been found to negatively impact psychosocial job stress by interacting with job strain that affects job satisfaction, organizational commitment and symptoms of infectious diseases (Leather, Beale, & Sullivan, 2003). An experiment shows that higher noise is also related to lower memory performance of workers, more tiredness and less motivation (Jahncke, Hygge, Halin, Green, & Dimberg, 2011) (Witterseh, Wyon, & Clausen, 2004). This motivation is affected more negatively when people remain in office noise during restoration. Another experiment found that office workers that were exposed to more noisy conditions are less likely to make ergonomic, postural adjustments which are a risk factor for musculoskeletal disorder (Evans & Johnson, 2000). A Swedish study found that workplace conflicts that worsen interpersonal relations are influencing to a large extent by noise disturbances, in particular among women (Danielsson, Bodin, Wulff, & Theorell, 2015). For open-plan offices, however, internal noise and proximity to colleagues may outweigh each other in terms of productivity due to crowding and interruptions against work interactions and knowledge sharing (Haynes, Suckley, & Nunnington, 2017).

Noise can be reduced with acoustic design. Better acoustical conditions are related to lower cognitive stress and less perception of disturbances (Seddigh, Berntson, Jönsson, Danielson, & Westerlund, 2015). The acoustic design of open-offices can reduce the distraction distance which affects subjective distraction and cognitive performance in short-term memory and working memory tasks. The intelligibility of background speech can be reduced when the speaker is at least four-to-six meters away from the office worker by using high room absorption, high screens and artificial speech masking sound (Roelofsen, 2008) (Haapakangas, Hongisto, Hyönä, Kokko, & Keränen, 2014).

Office Type

The office type is determined by the size of the office spaces, the office use as in territorial-workplaces or flex-workplaces, and the workplace layout as in the spatial configuration that is mainly characterized by enclosed offices, open-plan offices or activity-based offices.

Differences in health status and job satisfaction among workers are showed between office types. The highest scores for both health and job satisfaction are mainly found in enclosed offices and flex offices, whereas the lowest scores are generally found in open-plan offices. However, the scores also depend on the size of the office and the group size of workers (Danielsson & Bodin, 2008). So are workers in larger open-plan offices performing less than in smaller open-plan offices in terms of cognitively demanding tasks when the working conditions are normal compared to a quiet baseline with a low amount of irrelevant stimuli (Seddigh, et al., 2015). Performance is also investigated by Haynes et al (2017) in terms of workplace productivity wherein physical layout and social interaction points are identified to have the greatest impact but can outweigh each other in their benefits and their penalties. So are enclosed offices more productive because of privacy and limited distractions because open-plan offices suffer from crowding and interruptions, but open-plan offices may outweigh their productivity benefits due to their proximity to colleagues for interaction, knowledge sharing and access to informal meeting spaces. Moreover, occupants' priorities for workplace characteristics differ per office type (Kim & De Dear, 2013) (De Croon, Sluiter, Kuijer, & Frings-Dresen, 2005). Such relations indicate a similarity towards mental and social health in the office workplace. So are cognitive stress levels in open-plan offices and flex-workplaces found higher than in enclosed offices (Seddigh, Berntson, Danielson, & Westerlund, 2014) as well as enclosed offices score higher on satisfaction with sound privacy and visual privacy (Candido, et al., 2016). The type of offices, differed from enclosed offices, can also influence social health by the prevalence of workplace conflicts of primary women. This gender difference indicates that women possibly are more sensitive to stimuli in the workplace and may depend more on differences in interpersonal relationships and their social context when sharing a workspace with colleagues (Danielsson, Bodin, Wulff, & Theorell, 2015). Activity-based offices, also called flexible offices, are found to perform even better since they provide more space for social activities while also providing (the benefits of) enclosed workstations. These offices are associated with higher occupant satisfaction, overall work area comfort, overall building satisfaction, perceived productivity and health (Candido, et al., 2016) but score higher satisfaction levels among younger people and are less preferred by older people (Pullen, 2014).

Besides mental and social health, physical health may have influence since workers in open-plan offices and small size multi-person offices had more days of sickness absence than workers in enclosed offices (Pejtersen, Feveile, Christensen, & Burr, 2011). Two Danish studies also compared physical health aspects of enclosed offices with open-plan offices and show that occupants in open-plan offices are more likely to perceive worse thermal comfort, worse air quality, noise, frequent central nervous system complains and mucous membrane symptoms than occupants in small size multi-person offices and enclosed offices (Pejtersen, Allermann, Kristensen, & Poulsen, 2006).

In general, workplace productivity becomes more positive when workers' satisfaction increases about spatial factors, ability to personalize and the amount of space for working and storing. A quasi-field experiment of a refurbishment of an open-plan office that includes these factors found significant improvement in environmental and job satisfaction of office workers (Hongisto, Haapakangas, Varjo, & Koskela, 2016). But desk arrangement in workplaces, whether workers do have a pre-allocated desk or not, is also affecting self-reported health. So is the self-reported health of office workers with territorial-workplaces higher, although user-responsive design can play a role in non-territorial workplaces because workers assess their health higher when the comfort of furnishing is good (Kim, Candido, Thomas, & De Dear, 2016). In addition, the functioning of the workplace design of computer-based environments that support group and individual work can be optimized by providing training and information about the design to employees to reach more beneficial health effects (Robertson, Huang, O'Neill, & Schleifer, 2008).

Views

Views arise when offices have windows and the workstations in offices are orientated in a way that office workers can look through the window. It is proved that office workers that had windows in their offices report a higher overall quality of life (Dravigne, Waliczek, Lineberger, & Zajicek, 2008). The survey of Browning & Cooper

(2015) reports that stress levels, indicating negative mental health, are higher among people that have no window view and are lower when views have natural elements outside. Similar results are found in the studies of Aries, Veitch & Newsham (2010) and Lottrup et al (2015) which show that the view type and the view quality is affecting office workers' mental health wherein the nature view type is observed to predict higher mental health than the urban view type and the view quality positively increases mental health. Elzeyadi (2011) even associated poorer views with more sick leave hours, whereas office workers with natural views take the fewest sick leave hours, followed by workers with a view on urban structures and the worst for no views at all.

The innate affinity of humans with nature is proposed by Wilson (1984) with the term biophilia. This term is often used in research to describe the relation between de built environment and human health and wellbeing and to identify design elements to implement the concept (Kellert, Heerwagen, & Mador, 2008). Biophilia in office environments is affected by the view of a green environment outside or green elements inside. The exposure to natural elements is associated with several physical and mental health benefits of which natural views are consequently associated with healthier lifestyles (Grinde & Patil, 2009) (An, Colarelli, O'Brien, & Boyajian, 2016). Besides, providing nature views in offices via digital displays have been found not to positively nor negatively influence health compared to nature views through a window or just a blank wall (Kahn Jr, et al., 2008).

Although green elements inside the office do not fit the scope of this study since those are not influenced by the landlord, it is interesting to provide a little background on whether those influence office workers' health. So do 58% of the office workers have no greenery in their workplace Browning & Cooper (Browning & Cooper, 2015) but are offices that are enriched with natural aspects in the form of direct exposure with indoor plants as well as indirect exposure through pictures of plants are found to improve health (Bringslimark, Hartig, & Patil, 2007) (Largo-Wight, Chen, Dodd, & Weiler, 2011). Moreover, the wellbeing of office workers is even more when they are empowered to determine the amount and place of plants and pictures of plants (Knight & Haslam, 2010).

Provisions

Besides lease space for tenants, office buildings can also provide space for a variety of provisions. Some of those provisions can contribute to the health of the workers that use office buildings. In existing literature, most studies have found associations between facilities that focus on physical activity and nutrition. So, a meta-analysis found that the workplace can have large effects on motivational enhancement targeting physical activity and nutrition that contribute to physical health by mainly reducing the risk for cancer, diabetes and cardiovascular disease (Hutchinson & Wilson, 2011). Another study also states that worksite physical activity can reduce the intensity of neck, shoulder and musculoskeletal pain (Blangsted, Sogaard, Hansen, Hannerz, & Sjogaard, 2008). In a similar context, Blackford et al (2013) conducted a study to prevent overweight and obesity among office workers by health promotion through physical activity and nutrition. Their findings emphasize that it is the organizations' responsibility to support health since organizations challenge workers for long working hours. In order to determine how to provide this support, four predictors are set up that describe the behavior of office workers by means of the identification of multiple barriers and enablers of physical activity and nutrition. These predictors are total daily sitting time, total daily walking time, total daily physical activity time and total fruit and vegetable consumption. Via the four predictors, preferred intervention strategies that account to building characteristics are ensuring availability of activity programs and group classes that can be performed on the worksite, shower and change facilities, motivational signs (for instance a poster that encourages to take the stairs) and healthy nutrition options (Blackford, Jancey, Howat, Ledger, & Lee, 2013). Tangible building provisions for healthy nutrition promotion can be applied in food and beverage facilities such as (company) restaurants. Physical activity can be promoted in building provisions for exercise such as fitness and yoga. More explicit research on nutrition interventions is done by Mhurchu, Aston & Jebb (2010) which review study suggests that dietary behavior is influenced positively by workplace interventions through increased intake of fruit and vegetables and reduced intake of fat. They found environmental interventions of nutrition labeling, vending policies, (company) restaurant food supply/availability and menu reformulation.

Furthermore, services that support the work-life balance such as a childcare facilities and concierge services can yield health benefits as decreasing absenteeism, stress, tardiness as well as increasing worker morale (Earle, 2003) since these can facilitate a better work-life balance which improves workers' mental and physical health as well (Muster & Schrader, 2011). Moreover, social spaces can improve social health by well-designed breakout spaces that enhance workers' community through spaces where they can socialize, celebrate and share food and drink without disturbing others (Oseland, 2009) but also share knowledge (Weijs-Perrée, Appel-Meulenbroek, Arentze, & Romme, 2019). The office workplace is also recognized as a social environment for workers that enhances community, where especially informal non-desk spaces such as shared provisions of amenities and services for nutrition, wellbeing and events are available (Harris, 2015).

2.7   CONCLUSION

In this first part of the preliminary study, the understanding of the healthy office workplace as outlined in this chapter by conducting a literature study. It tracked down that increased attention for health in the office workplace comes from a contemporary way of thinking wherein human capital is seen of great importance for organizations' performance and that better health of workers is driving human capital to its best. Better health of workers does not only enhances the performance of organizations by lowering absenteeism and presenteeism rates including spillover effects, but it also can lead to higher productivity, organizational effectiveness, competitive advantages and positive influences on attracting and retaining talent. To understand health in the office workplace, this chapter answered the sub research question '*What is the healthy office workplace and which aspects can be influenced by landlords?*'. Health in this thesis is considered as the combination of physical health, mental health and social health which all can be protected to avoid negative health consequences but also can be promoted to pursue positive health outcomes. A healthy office workplace aligns this optimally with the totality of workplace aspects in order to maximize the performance of organizations' human capital. The in-depth literature study identified seven office workplace aspects with multiple characteristics that can be influenced by landlords and have effect on various health aspects. Aspects concerning the office Indoor Environment Quality (IEQ) have been identified by (1) Indoor Air Quality, (2) Thermal Comfort, (3) Light Exposure and (4) Noise & Acoustics. Spatial and aesthetic office aspects are identified by (5) Office Type and (6) Views. Services and facilities in (proximity of) the office building are identified by (7) Provisions. Table 2 provides the totality of characteristics (influenced by landlords) per aspect, sorted on type of health.

Table 2. Office workplace characteristics (influenced by landlords) per aspect, sorted on type of health

ATTRIBUTE	Characteristics (influenced by landlords])	Physical	Mental	Social	Source
Indoor Air Quality	Ventilation rate		x		Seppänen, Fisk, & Lei (2006)
	Ventilation rate, odors	x	x		Wargocki et al (2000)
	Ventilation rate, perceived air quality	x	x		Seppänen, Fisk, & Mendell (1999)
	Ventilation rate, VOCs, CO2 concentration		x		Park & Yoon (2011)
	VOCs, CO2 concentration		x		Satish et al (2012)
	VOCs, CO2 concentration		x		Allen et al (2016)
	VOCs	x	x		Wolkoff (2013)
	Humidity, perceived air quality	x	x		Wolkoff & Kjærgaard (2007)
	Humidity	x			Sunwoo et al (2006)
	Humidity	x			Reinikainen & Jaakkola (2001)
	Humidity (dampness)	x			Bornehag et al (2001)
	Air quality satisfaction, personal control		x		Huizenga et al (2006)
Thermal Comfort	Thermal comfort		x		Huang et al (2012)
	Temperature	x			Seppänen, Fisk, & Lei (2006)
	Temperature (warmth)	x	x		Lan et al (2011)
	Temperature (warmth)	x			Reinikainen & Jaakkola (2001)
	Temperature (warmth)	x	x		Witterseh et al (2004)
	Temperature (cold)	x			Parsons (2014)
	Temperature satisfaction, personal control		x		Huizenga et al (2006)
	Personal control		x		Karjalainen & Koistinen (2007)
	Gender differences		x		Karjalainen (2006)
Exposure to Light	Daylight (windows), illuminance	x	x		Galasiu & Veitch (2006)
	Daylight (windows)	x			Elzeyadi (2011)
	Daylight (windows)	x	x		Boubekri et al (2014)
	Daylight (visual, circadian))	x	x		Boyce, Hunter & Howlett (2013)
	Daylight (windows), glare		x		Heschong (2003)
	Personal control		x		Chraibi et al (2016)
	Window blinds, personal control		x		Meerbeek et al (2016)
	Daylight (windows), glare	x	x		Hedge & Nou (2018)
	Daylight (windows), circadian lighting		x		Figueiro et al (2014)
	color temperature, illuminance, personal control		x		Manav (2007)
	Artificial light (direction, color, flickering)	x	x		Boerstra & Van Dijken (2015)
	Color temperature		x		Sivaji et al (2013)

Category	Factor				Reference
Noise & Acoustics	Background noise		x	x	Boerstra & Van Dijken (2015)
	Irrelevant speech		x		Hongisto (2005)
	Irrelevant speech & background noise		x		Banbury & Berry (1998)
	Noise disturbance		x		Leather, Beale & Sullivan (2003)
	Noise disturbance		x		Jahncke (2011)
	Noise disturbance		x		Witterseh, Wyon & Clausen (2004)
	Noise disturbance	x	x		Evans & Johnson (2000)
	Noise disturbance		x	x	Danielsson et al (2015)
	Noise disturbance, interaction			x	Haynes, Suckley & Nunnington (2017)
	Acoustic design	x	x		Seddigh et al (2015)
	Acoustic design		x		Haapakangas et al (2014)
	Acoustic design		x		Roelofsen (2008)
Office type	(Group) size, spatial configuration	x	x		Danielsson & Bodin (2008)
	Office size		x		Seddigh et al (2015)
	Spatial configuration		x	x	Haynes, Suckley & Nunnington (2017)
	Spatial configuration		x	x	Kim & De Dear (2013)
	Spatial configuration, office use		x	x	De Croon et al (2005)
	Spatial configuration		x		Seddigh et al (2014)
	Spatial configuration		x		Candido et al (2016)
	Spatial configuration			x	Danielsson et al (2015)
	Spatial configuration				Pullen (2014)
	Spatial configuration	x	x		Pejtersen et al (2011)
	Spatial configuration	x	x		Pejtersen et al (2006)
	Spatial quality		x		Hongisto et al (2016)
	Desk arrangement		x		Kim et al (2016)
View	View through window		x		Dravigne et al (2008)
	Biophilic design, (natural) view type		x		Browning & Cooper (2015)
	(Natural) view type, view quality	x	x		Aries, Veitch & Newsham (2010)
	(Natural) view type, view quality	x	x		Lottrup et al (2015)
	(Natural) view type	x			Elzeyadi (2011)
	Biophilic design	x	x		Kellert, Heerwagen & Mador (2008)
	(Natural) view type	x	x		Grinde & Patil (2008)
	(Natural) view type	x	x		An et al (2016)
	Indoor plants, pictures of plants	x			Bringslimark, Hartig & Patil, 2007
	Indoor plants, pictures of plants, personal control		x		Knight & Haslam (2010)
Provisions	Physical activity, nutrition	x			Hutchinson & Wilson (2011)
	Physical activity	x			Blangsted et al (2008)
	Physical activity, nutrition	x			Blackford et al (2013)
	Nutrition	x			Mhurchu, Aston & Jebb (2010)
	Supporting work-life balance	x	x		Earle (2003)
	Supporting work-life balance	x	x		Muster & Schrader (2011)
	Community, social spaces			x	Oseland (2009)
	Community, social spaces			x	Weijs-Perée et al (2019)
	Community, shared spaces			x	Harris (2015)

3. TENANTS' DECISION MAKING ABOUT OFFICE ACCOMMODATION

Office space in multi-tenant business centers is rented by a variety of organizations. Each organization has generally different preferences for the office space they need of which preferences are influenced by the type of organization. Therefore, this chapter attempts to identify characteristics that influence organizational decision making for office workplace accommodation. These characteristics are useful to include together with the preference for healthy office workplace aspects in the explorative study. The typology of tenants in this chapter is categorized in organizational characteristics including awareness for workers' health, along with organizations' preferences for building characteristics, location characteristics and rental prices.

3.1 DECISION MAKING THEORY

Before identifying characteristics that influence tenants' decision making of office workplace accommodation, it is relevant to understand the theory behind the making of decisions. Two basic concepts of decision theories can be distinguished: normative and descriptive decision theory. Normative theories intend to explain what decision makers rationally require to make decisions. Descriptive theories are empirical and are intended to explain how decision makers make decisions. This research focusses on the descriptive theories since it considers how tenants make decisions based on their preferences. It is an empirical discipline that belongs to experimental psychology (Peterson, 2009).

Decisions can differ in being right or being rational. A right decision is made when the actual outcome is at least as good as all other possible outcomes. A rational decision is made based on the outcome that has the most reason in the time the decision is made. An important note is also that "a decision can be rational without being right and right without being rational" (Peterson, 2009), since the actual outcome of a decision is uncertain. A rational decision can still become wrong when a certain unexpected circumstance appears after making the decision and vice versa. Nonetheless, it is more reasonable to operate rationally because that is based on the information that is available at the point in time that the decision is made. This is called instrumentally rationality, meaning that it follows the aim of the decision maker. In the explorative research, it is assumed that the decision makers follow this instrumentally rationality.

In this research, decision making is focused on the view of organizations that often consists of a group of people. In decision theory, decisions from groups can be represented in two main ways being the social choice theory and the game theory. The social choice theory is about how decisions are ought to be made when multiple decision makers are involved. For organizations, this can be for instance the board of directors. Nonetheless, not every choice made by a group is a social choice because groups can elect single people to make the choice for them. In many organizations, people have a specific function that relates to certain responsibilities for which they are allowed to make decisions. The game theory is based on what others are doing and is thus influenced by trust and adjust in a more dynamic situation (Peterson, 2009). In the explorative research, social choice theory is applicable because it concerns the preference of decision makers being representatives of organizations.

The decision itself has three main components that determine what people decide about, being acts, states and outcomes (Peterson, 2009). *Acts* can be seen as instruments to reach the desired outcomes for which *states* can be seen as devices that are needed for the application of these instruments. Acts are the possible decisions people can make and thus can choose from. The acts that are assumed by the decision maker are called alternative acts. The chosen act is the function from the set of states and the set of outcomes that are involved in the decision problem. The *states* affect the decision maker's preference for the acts that are taken into account. A state cannot be performed by the decision maker (but an act performed by others can be a state) and thus is an external influence. Outcomes are attached to states. The *outcome* of a choice is what ultimately matters. The ranking of outcomes can differ per decision maker because it involves the subjective attitude of the decision maker towards the outcomes. The likelihood of an outcome will occur is called the probability. The classical interpretation of probability is the factor of which a specific event outcome as a fraction of the total number of possible outcomes (Peterson, 2009). The simple example, therefore, is the probability of throwing an even number with a dice, which is 3/6. Further interpretation of probability in this research is also addressed in chapter 4.

Now the theory behind the components is explained, it is important to identify what the components imply for this research. The acts are the answer possibilities of the questions in the questionnaire that the decision makers of organizations' office accommodation can make. These acts will further be refined in chapter 4 wherein the acts are the *alternatives* in the Stated Choice Experiment. The outcomes are the preferences of the decision makers for healthy office workplace aspects and should not be confused with the healthy office workplace outcomes of section 2.2. In decision theories, the quantitative valuations of the outcomes are called *utilities* of

which explanation is given in chapter 4. With all the single utilities of decision makers, the probability of an overall preference of decision makers of organizations' office accommodation can generally be estimated, which explanation is given in chapter 5.

In this research, the states are the *independent variables* and can be considered as the backgrounds of tenants. These will be discussed in the following sections of this chapter. The addressed characteristics have been found in literature to influence real estate accommodation of organizations. Furthermore, policies and strategies that organizations can implement regarding workers' health are addressed to identify decision makers' awareness of health in the workplace.

3.2 ORGANIZATIONAL CHARACTERISTICS

Primary activity

The primary activity of organizations in the Netherlands is generally allocated conform to the SBI-classification (Standaard Bedrijfsindeling) of the Centraal Bureau voor de Statistiek (CBS), the national statistical office in the Netherlands (CBS, 2019). The SBI classifies economical activities through sector/branches and is based on the Nomenclature statistique des activités économiques dans la Communauté Européenne (NACE Rev 2) of the European Union and the International Standard Industrial Classification of All Economic Activities (ISIC Rev 4) of the United Nations. The primary activities can indicate the magnitude of a certain demand in order to make market estimations and profiling of organizations. Moreover, the SBI-classification is a format that can be combined with external datasets of the CBS for in-depth analysis. In the context of workplace health, it is possible that certain sectors focus more on workers' health because they may believe in the organizational outcomes of a healthier workforce such as the 'war on talent' in a specific sector.

Size of the organization

The size of an organization is also a commonly used characteristic of an organization and is in terms of office space tangible as the number of workers that use the office space because every worker needs a minimum level of workplace space (Stichting Nederlands Normalisatie-Instituut, 2010). A common measure of the size of an organization is the full-time equivalent (FTE) of employment since this measure makes organizations better comparable when different people work different hours per week and thus concerns the average number of hours worked (Eurostat, 2019). The number of workers that are using an office can influence the importance for an organization to invest in the quality of the office space. When there are working more workers of an organization in a particular office, the quality of that office influences the organizations' total performance more. Keeping that in consideration, an organization may be willing to pay more for the health quality of an office where more of their workers make use of.

Maturity of the organization

Decision making of real estate accommodation is also dependent on the maturity of the organization. Stam (2007) explained that the spatial allocation of an organization co-evolves with the development of an organization, in this study termed maturity. The study distinguishes five development phases: start-up, initial survival, early growth, growth syndrome, accumulation. Among them, three main distinctions can be made that may lead to changes in the organizations' spatial allocation mainly because these are identified with the recognition of new opportunities in the existing market and new branches. In the start-up and initial survival phases, organizations are mostly unilocational in the home region. In the subsequent early growth and growth syndrome phases, organizations are likely to expand outside the home region in mostly national branches. The spatial allocation beyond the growth syndrome and accumulation phase is expanding also in international branches (Stam, 2007). The maturity insists not only macro decision making factors of spatial allocation but also micro decision making factors of building specifications (Haynes, 2012). Both types of decisions support and enhance the organizational DNA purpose and culture that have a specific demand for space. Maturity can be estimated with the age of a firm of which Stam (2007) distinguished three classes. Starting organizations with high failure rates have to survive the first 4 years of existence to develop to growing organizations in the following 4 – 11 years. Organizations more than 11 years old can be addressed as mature. Another indicator of maturity can be the number of workers of organizations, but that category can contain more exceptions (Stam, 2007). On the one hand, it is possible that organizations that are less mature have less focus and capital for health since they need maximum focus on succeeding their core business instead of strengthening their current business with workplace health. Therefore, they might not invest in healthy office workplaces. On the other hand, they can outsource that focus through leasing a healthy office workplace in order to benefit from the advantages that the landlord provides.

Organizational focus

Each organization has a different value proposition in the market they are present to deliver a specific product for a certain target group. According to Treacy & Wiersema (1995) the organizational focus is identified by value disciplines, that are mainly distinguished in operational excellence, product leadership and customer intimacy. Each discipline does not leave the other out of consideration but is the main stake in the organizations' market reputation. Operational excellence is about costs and efficiency, meaning organizations that obtain the middle of the market at the best price for the least inconvenience to tap into the mass-market. Product leadership is the value displace that strives for the product performance, being the best provider for a specific product by upgrading it year after year. Customer intimacy focuses on relationships with customers and intimate knowledge by satisfying their unique needs instead the needs of the market. In their value disciplines, organizations combine their capacities to deliver the end product they are offering (Treacy & Wiersema, 1995). Real estate belongs to these capacities, including the quality of healthy office workplace aspects. Because value disciplines determine the allocation of capacities, they fit in the scope of this research.

Purpose of accommodation

The decision making of organizations' accommodation is also influenced by the purpose of making the decision. Decisions for buildings and facility services can be done using the Value Adding Management (VAM) model, which is a decision-support and management tool that follows the classic input-throughput-output triplet with a distinction between output, outcome and added value (Van der Voordt, Jensen, Hoendervanger, & Bergsma, 2016). This model is a good form to assess the added value of a building intervention. In the case of this thesis, the input are improved healthy workplace aspects. Via the throughput of the management of the implementation process, the output is a healthier work environment. The outcomes of this output are considered in chapter 2 and are for instance increase a decrease in absenteeism or attracting talent. On strategy level, the added value is considered by Lindholm & Leväinen (2006) which made a framework including strategies of the added value of corporate real estate. These strategies are increasing the value of assets; promoting marketing and sales; increasing innovation; increasing employee satisfaction; increasing productivity; increasing flexibility; and reducing costs. In addition, contemporary strategies are including sustainability as well as an important factor that influence decision making (Remøy & Van der Voordt, 2014). Because these added values are part of an iterative process of decision making in strategy forming, they can also be interpreted as 'states'. In that context, the added values can influence the choice for improving health in the workplace. So, the strategies of Lindholm & Leväinen and Remøy & Van der Voordt will fit in the focus of this research with the exception of the value of assets, because this not of interest for tenants but for landlords.

Policies and strategies regarding workers' health

Because this study is about health in the workplace, it is important to consider the awareness of this subject. Organizations that do promote health among their workers are doing this by investing in health or wellness programs for their employees. Baicker, Cutler & Song (2010) made a characterization of these programs in their method of delivery. The peer-reviewed meta-analysis included five interventions: health risks assessment; self-help education materials; individual counseling; classes, seminars, group activities; added incentives for participation. All the interventions can be applied for preservation or promotion that focus on physical, mental and social health. The study of Anger et al (2015) considers more specific interventions that can all be categorized in the same characteristics mentioned by Baicker, Cutler & Song (2010). When organizations do not have awareness of the benefits of health, they probably do not invest in it. The reasons therefor can be diverse. The sequential global survey of Buck Consultants by Xerox Corporation (2014) shows several motivations not to have a health strategy. These motivations can be economical and organizational as well as the level of support of the management or the employees. A distinction of motivations is made in lack of budget; missing know how to organize or get started; insufficient management support; lack of business case to support implementation of wellness strategy; insufficient internal ownership; belief that managing employee health is not the role of the organization; incompatible company culture with wellness messages. The interaction of organizations with health interventions differs because every organization acts differently regarding the demographic profile of their company (Terry, Grossmeier, Mangen, & Gingerich, 2013). Nonetheless, the presence of policies and strategies regarding workers' health can be considered as a 'state' in this study since it influences decision making about healthy office workplace aspects in terms of awareness within an organization. Likewise, the interventions or reasons to not have such policies and strategies are a deepening on that 'state' and can thus be considered as 'states' as well.

3.3 BUILDING CHARACTERISTICS

Business center concept

Business centers can be classified in mainly four concepts of which more than one concept can be applied in one business center (Weijs-Perrée, Appel-Meulenbroek, De Vries, & Romme, 2016). Each concept is identified by characteristics regarding the objective, tenants, spaces, atmosphere and facilities/services that all influence tenants' decision making of multi-tenant business centers. Nonetheless, the results show that "with regard to the physical part of the concepts all business centers are rather uniform and can be offered in similar objects" (Weijs-Perrée, Appel-Meulenbroek, De Vries, & Romme, 2016). The four concepts proposed by Weijs-Perrée et al. (2016) are the regular business center, serviced offices, co-working offices and incubators. The regular business center is the classic multi-tenant concept with relative long lease contracts without specific tenants, objects, shared spaces of service levels. Serviced offices often handle short lease terms with the pay-as-you-use concept, concentrate on small organizations or self-employed people and provide a variety of (shared) spaces with a high service level. Co-working offices offer mostly a one-year lease contract, focusing on tenants that desire knowledge transfer and a working community. Moreover, co-working offices provide a variety of (shared) spaces and some services. Incubators are mostly non-profit so do not have a fixed leasing contract focusing on start-up tenants.

The four concepts can be interesting to assess as a 'state' where tenants currently rent because it indicates a current preference for a certain concept. In turn, that indicate preferences and willingness to pay for healthy office workplace characteristics that are commonly applied in that concept which might be higher in serviced offices. For landlords, this is interesting as well since they decide on the concept they apply to attract tenants. If more tenants have a preference for a certain concept (with a certain level of workplace health), landlords should consider investing more in corresponding (healthy) office workplace aspects when they desire to attract that type of tenants.

Other building characteristics

There are numerous other building characteristics that influence decision making which can differ strongly per building. In the basis, these can be identified via preferences for real estate interventions which are (1) maintenance, (2) functional adjustment, (3) reshuffling, (3) (partial) renovation and (4) new building (De Vries, De Jonge, & Van Der Voordt, 2008). The identification of preference of tenants for building characteristics can also be done with several other indicators. Vacancy of office space that is rented can be seen as an indicator to identify building characteristics that are relevant for tenants since it shows the mismatch between demand and supply (Remøy, Koppels, Van Oel, & De Jonge, 2007). Moreover, push and pull factors (Pen, 2002) (Pellenbarg, 2005), as well as keep factors (Appel-Meulenbroek, 2008) can be used as indicators because those can show whether tenants would like to move or not to move to a new office concerning current preference for building characteristics. Nonetheless, all mentioned indicators are decision acts and not states thus not relevant for this chapter. But the various building characteristics that they can identify might influence workplace health of which the one within the focus of this study is described in chapter 2.6.

3.4 LOCATION CHARACTERISTICS

Location characteristics generally concern an immovable area. The literature review of Remøy et al (2007) identified location characteristics with a vacancy indicator by accessibility by car, accessibility by public transport, business cluster, facilities, safety and status. Furthermore, the research of Jansen (2009) identified a wide segmentation of location characteristics for the choice of business accommodation in offices. The research distinguishes location characteristics in 'soft' and 'hard' wherein 'soft' characteristics are more qualitative as appearance and image of the district and 'hard' characteristics are more geographical as accessibility. Moreover, the preference for locations of an office market is driven by the demography of a region such as the labor market, the mix of functions in the area and nearby business relations (IVBN & JLL, 2017). All location characteristics might relate to health by means of forced physical activity by for instance walking from public transport to an office building, facilities in the area that promote health such as the 'provisions' that are described in chapter 2.6, degree of air pollution in the area or workers' wellbeing in the area about for instance its safety and status.

3.5 RENTAL PRICE

Undoubtedly, the rental price of office space influences decision making. In the office rental market, the rental price is the equilibrium determined through the demand for office space of tenants and the supply of office space of landlords.

3.6 CONCLUSION

This second part of the preliminary study elaborated via decision making theory that a decision maker's preference for healthy office workplace aspects (outcomes) influences the possible decisions (acts) which are relevant to the characteristics of the background (states) of the choice situation. The identification of these 'states' answer the sub research question: *'What are the aspects that influence organizational decision making for office workplace accommodation?'*. In order to answer this question, existing literature that identified influences on organizations' decision making of real estate accommodation is examined. In addition, policies and strategies that indicate awareness of health in the workplace are investigated since awareness is also a 'state' that is relevant to the scope of this thesis. An organization's primary activity, size, maturity, focus and purpose of accommodation are identified to be relevant organizational characteristics. Interventions for preservation and promotion health as well as motivations of organizations not to invest in it are found to indicate organization's awareness of health. Real estate interventions, vacancy, push, pull and keep factors are indicators for various building characteristics, but the business center concept is of relevance in this research since these are applicable to the multi-tenant business centers that this thesis focuses on. Various indicators for location characteristics are distinguished in 'soft' and 'hard' factors wherein 'soft' characteristics are more qualitative and 'hard' characteristics are more geographical. Among location characteristics, the demographical characteristics of a region such as the labor market and near business relations can also be considered. Last, the rental price influences organizational decision making for office workplace accommodation which value is determined by demand and supply in the office market.

4. METHODOLOGY

Previous chapters identified which healthy office workplace aspects can be influenced by the landlord and how tenants make decisions about their organizations' office accommodation. In existing literature, no evidence can be found that explains the role of healthy office workplace aspects in this decision making of tenants and how they value those. To find evidence for that research gap, this chapter outlines the methodology that is applied in this research in order to collect data that generate appropriate results. The methodology describes the theoretical analysis of the selected research method as well as the specific implementation of this method to execute this research. First, it is explained why the selected method is chosen to conduct this research. Second, the scientific theory of the method is discussed. Third, the experimental design that forms the foundation of the analysis is given that contains the operation of the identified aspects of chapters 2 and 3. At last, the structure of the survey questionnaire is elaborated.

4.1 METHOD SELECTION

The objective of this research is to identify which healthy office workplace aspects are beneficial to invest in by landlords through investigating preferences of tenants regarding trade-offs between particular aspects. The preliminary research of chapter 2 and chapter 3 provided a selection of healthy office workplace aspects and aspects that influence decision making of organizations about their office workplace accommodation. All these identified aspects are included in the subsequent research phases. There are multiple methods that gain more insight into choice behavior of a certain population. In order to select the most suitable method that generates appropriate results for the objective of this research, several methods are considered. The precondition of the method selection is that it can elicit the **Willingness To Pay** (WTP), a measure of the value of nonmarket goods that questions how much an individual or an organization is willing to pay for a certain outcome (Breidert, Hahsler, & Reutterer, 2006). This section briefly describes the considered methods as well as it explains why the method that is used for this research is selected and why the other methods were not.

Among qualitative research methods, the **Focus Group Interview** can be a suitable technique to identify preferences of a specific population following a pre-established plan. In this method, the preselected group is interviewed by a trained moderator in order to find attitudes, knowledge or social representations for that specific group. Nonetheless, the interaction in the group may shift an individuals' initial perspective in the search for common ground in the group individuals (Hydén & Bülow, 2003). Moreover, interviews are influenced by the situation in which the interview is conducted and by the moderator that is taking the interview. Therefore, it is of importance that the interview situation is standardized and that the social cues are minimalized. An exception can be made when the interviewee is a subjective, irreplaceable person (Opdenakker, 2006). When conducting multiple individual interviews in a specific population, the **Laddering Interview Method** seems to be the most suitable since it emphasizes the informal and social mechanisms within organizations and the role of personal values of individual managers and other organizational actors (Bourne & Jenkins, 2005). Nonetheless, including an objective monetary factor to derive specific weights of the WTP-outcome seems very difficult in this method, since it considers more how people mentally map a subject.

Among quantitative research methods, research can be conducted by analyzing existing market data. The WTP for healthy office workplace aspects can be extracted through analyzing existing longitudinal market data with **Hedonic Price Regression**. This method can explain the price increase of the transformation of a low health quality office to a healthy office by extracting principal determinants of office rents over time (Dunse & Jones, 1998). Nonetheless, this method is less suitable for this research because the hedonic price method encounters a whole transformation over time and cannot make sharp trade-offs between individual healthy office aspects. Furthermore, there is less useable data existing yet of complete transformations from low health quality offices to healthy offices.

Also, the comparison of datasets with rental values of low health quality offices and healthy offices is possible, wherein healthy office workplace determinants are tested for differences while correcting for other determinants or through keeping them constant. The use of a **Bayesian Belief Network** can derive and predict the direct and indirect relationships between the variables (Cooper, 1990) embodying a monetary factor as the rental price to obtain the WTP. Also this method is less suitable for conducting this research since the healthy office workplace is a rather new development. This entails that there are not enough cases in practice that can be considered or compared with each other, especially when including the total of healthy office aspects while keeping other variables constant. That causes the problem there are no existing datasets available that encounter the importance of healthy office workplace aspects.

Because the healthy office workplace is a relatively new office concept, it is more logical to conduct a hypothetical experiment to generate new data. This can be done by asking respondents to rate healthy office

workplace aspects as well as asking them to connect monetary values to the separate aspects. Through running a **Linear Regression** of the data from a survey, the ratings and the monetary values can be related in order to identify the WTP. Nonetheless, this technique does not force respondents to make trade-offs concerning all aspects and thus make it difficult to assign direct utility.

A **Stated Choice Experiment** where respondents take multiple attributes into account per choice instead of rating attributes separately seems therefor the most suitable solution for this research. Within the experiment, respondents repeatedly make choices from a set of alternatives considering hypothetical situations (Hensher, Rose, & Greene, 2005). Each choice alternative consists of varying levels based on an experimental design of a fixed combination of multiple attributes. The WTP can be estimated through including a financial attribute so the ratio between the monetary attribute and the other attributes will provide the WTP for that attribute (Hensher, Rose, & Greene, 2005). This method must not be confused with revealed preferences (RP) which observe or report the actual behavior of individuals in the real world. It is about stated preferences (SP) that observe or express the response of individuals to hypothetical alternatives (Hensher, Rose, & Greene, 2005), which concerns this thesis. Stated preferences have a couple of advantages. It enables to research new activities products, facilities or services more easily. It also makes it possible to research multiple observations per respondent. Moreover, there is no or low correlation between the attributes of each alternative. A disadvantage of stated preferences is that the choices that respondents make are not under real-world conditions.

4.2 METHOD THEORY

In paragraph 3.1, general decision making theory is explained with acts, states and outcomes that decision makers consider when making a choice. It was explained that the states are the *independent variables* and can be considered as the backgrounds of tenants and that the acts and outcomes are discussed in this chapter as respectively *alternatives* and *utilities*. These terms belong to a Stated Choice Experiment (SCE) which fall under so-called applied choice analysis. To clarify the theory of a SCE, it is insightful to explain the functioning of such analyses. People make choices based on a set of preferences and constraints they take into account to maximize the satisfaction level of their personal or community-based objective (Hensher, Rose, & Greene, 2005). The set of constraints is called a *choice set* in which the constraints are called *alternatives*. When people make a choice, they consider at least two alternatives. More in detail, each alternative relies on a range of characteristics which are called *attributes* that can be broken down by so-called *attribute levels*. People's choices are not only based on available alternatives. Also personal or communal characteristics could affect a choice which is often influenced by *socio-economic characteristics* (SECs). These SECs are unconditional characteristics that are related to individuals or organizations that determine specific demands in order to satisfy needs.
The distribution of all choice differences in a certain population determines the amount of *variability*. The challenge of conducting research is to maximize the identification of the present *variability, so* the estimation of demands of the concerning population is the closest to reality. The distribution of the variability is called *heterogeneity*. When the heterogeneity of data is high, the captured data provides a more complete explanation of choice behavior. An alternative or additional approach to eliminate unmeasured variability (also called unobserved heterogeneity) is to hold other influences that are not included in the research constant, defined with the expression *ceteris paribus* (Hensher, Rose, & Greene, 2005).

In this thesis, the identification of the variability consists of the attributes and attribute levels of the healthy office workplace aspects that are established in chapter 2 as well as the socio-economic characteristics being the aspects that influence organizational decision making for office workplace accommodation that is identified in chapter 3. In the experiment, respondents are informed to assume *ceteris paribus* for all other attributes or attribute levels that are not included.

Because this research contains a large variability of attributes and attribute levels that must be included in one choice to reveal trade-offs, a discrete choice experiment is an appropriate method. Discrete choice models can predict choice between alternatives and is a multivariate technique that measures the preference of individuals and the choice behavior for alternatives that are hypothetical. A discrete choice model estimates an overall demand as a sum of choices of disaggregated level data that are derived from individuals. In order to understand how this demand is estimated, it is needed to understand how a stated choice experiment is statistically modeled.

The objective of a statistical model is to determine relations between two or more attributes or levels of attributes. Therefore, a statistical model must identify what relations exist and what the strengths of those relations are. In statistics of applied choice analysis, such relations are termed *utilities* as a value of satisfaction. Positive utilities can also be interpreted as useful, profitable or beneficial when approaching it in the context of organizations. Every respondent has a different perceived value of the attributes as well as a certain preference

for the level of the attributes. The highest *overall utility* determines which alternative a respondent will choose (Hensher, Rose, & Greene, 2005). From multiple chosen alternatives, parameters of attributes and attribute levels can be estimated to identify preference tradeoffs.

Random Utility theory

Discrete choice modeling is based on the Random Utility Theory that is subjected to certain assumptions. The first assumption is that the model consists of individual sets of choice alternatives. Second, it is assumed that all alternatives have attributes. The third assumption is that individuals derive utility from these attributes. Fourth, the preferences can differ between and within individuals. At last, each individual selects the maximum-utility alternative (Hensher, Rose, & Greene, 2005).

The random utility theory states that the utility (U) of the alternative (i) that is chosen by the respondent (q) contains the structural utility (V_{iq}) that can be estimated, added with the random utility (ε_{iq}) that cannot be observed. This makes the equation of the random utility model as follows:

$$U_{iq} = V_{iq} + \varepsilon_{iq}$$

Each attribute (n) contains a score (X_{inq}) that is multiplied with an associated weight parameter (β_n) of that attribute. The summation of the values for all attributes in alternative results in the structural utility component of that alternative and is denoted with:

$$V_{iq} = \sum_n \beta_n X_{inq}$$

The random utility component of an alternative represents the taste variation and the measurement error. Integrating this component in the equation of the random utility theory gives the following equation:

$$U_{iq} = \sum_n \beta_n X_{inq} + \varepsilon_{iq}$$

This formula can be used to calculate the overall utility of an alternative that enables to determine the probability (P_{iq}) of that the alternative will be chosen by an individual from the set of alternatives (j). There are two main models that follow different assumptions of the unobserved effects. In *probit* models, unobserved effects are assumed to follow a multivariate normal distribution. In *logit* models, the most common type, unobserved effects are assumed to follow a multivariate generalized Extreme value (GEV) distribution (Hensher, Rose, & Greene, 2005). This thesis follows the logit model because this is sufficient since this research has an exploratory character. It is important that there is no ambiguity between attributes to avoid inter-attribute correlation or that attributes are proxies of each other. Therefore, it is assumed that the random utility is independently and identically (IID).

Multinomial Logit Model & Latent Class Model

The multinomial logit model (MNL) is used to determine the probability with homogeneity for the whole sample, using the equation:

$$P_{iq} = \frac{\exp(V_{iq})}{\sum_{i'} \exp(V_{j'q})}$$

In order to find heterogeneity in the sample, the Latent Class (LC) model is used as an extension of the MNL. The LC model can identify different segments in the sample based on similar stated preferences of individual respondents. These segments are called classes. Each class (c) is determined by similarities in patterns of parameters of the observed attributes and so indicate latent structures of preferences. Subsequently, other characteristics of respondents such as the SECs can be compared to the classes in order to find similarities. For each respondent, the probability of belonging to a class ($P_{q|c}$) can be computed. Mostly, a respondent does not belong exactly to one specific class which is why a respondent will be assigned to the class with the highest probability. The formula for the probability of belonging to a class is:

$$P_{q|c} = \frac{\exp(V_{i|c})}{\sum_{j'} \exp(V_{j|c})}$$

When the data is gathered, the probability can be used to calculate the likelihood that an individual will choose an alternative. The likelihood is the plausibility of the parameters that the model estimates. This plausibility impacts the performance of the model, entitled as the goodness-of-fit which can be calculated with the indicator McFadden's Rho-Square (ρ^2). This coefficient is the proportion of variance that is explained by the model. A higher Rho-square explains a higher variation of the model which is always a value between 0 and 1 and preferably a value higher than 0.200 (Louviere, Hensher, & Swait, 2000).

$$\rho^2 = 1.0 - \frac{LL(\beta)}{LL(0)}$$

The Rho-square is dependent on the log-likelihood of the estimated model (LL(β)) and the log-likelihood of the null model (LL(0)) in which all the weights are zero thus represent an equal preference for an alternative. The formula of the log-likelihood is stated below, in which the value of component y_{iq} is 1 when an alternative is chosen by the respondent and 0 otherwise.

$$LL(\beta) = \sum_q \sum_i y_{iq} \ln(P_{iq})$$

Because this model includes a high number of parameters due to the fact that it contains a lot of alternatives, the Rho-Square must be adjusted by including the number of alternatives (N_{alt}) and the number of parameters in the model (N_{par}). This lead to the adjusted Rho-Square conform to the equation:

$$\rho^2_{adj} = 1 - \frac{N_{alt}}{(N_{alt} - N_{par})} * (1 - \rho^2)$$

4.3 EXPERIMENTAL DESIGN

The base of the stated choice experiment is defined in eight stages in the experimental design of figure 2. All the phases are passed in order to create a proper survey instrument. In some stages, it is possible to return to revise a previous design stage. The experimental design begins with the problem refinement, which is described in the introduction chapter of this thesis. The other stages are described in this paragraph.
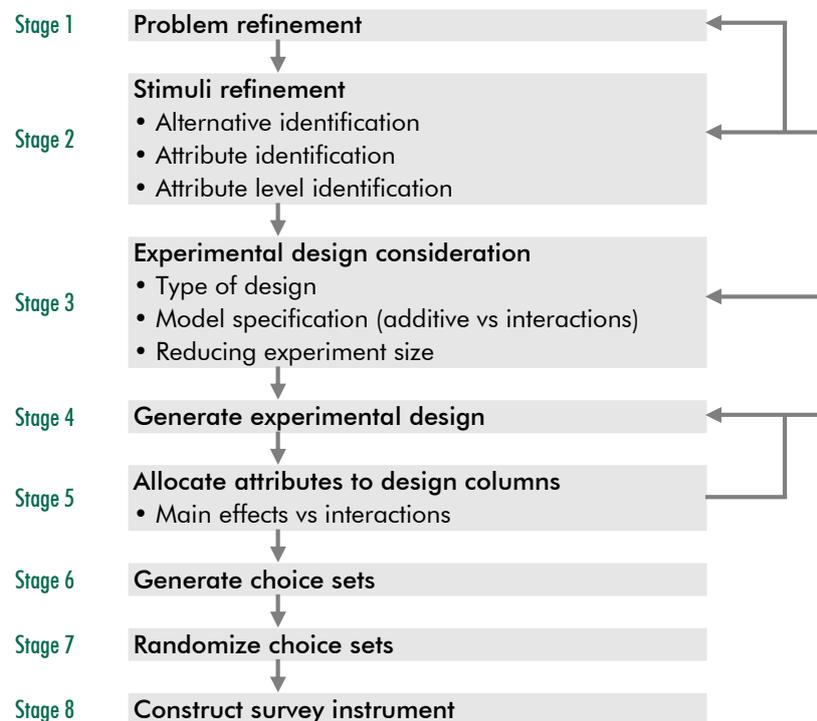
Stage 1 — **Problem refinement**

Stage 2 — **Stimuli refinement**
- Alternative identification
- Attribute identification
- Attribute level identification

Stage 3 — **Experimental design consideration**
- Type of design
- Model specification (additive vs interactions)
- Reducing experiment size

Stage 4 — **Generate experimental design**

Stage 5 — **Allocate attributes to design columns**
- Main effects vs interactions

Stage 6 — **Generate choice sets**

Stage 7 — **Randomize choice sets**

Stage 8 — **Construct survey instrument**

Figure 2. Experimental design (Source: Hensher, Rose & Greene, 2005)

In the second stage, stimuli must be refined referring to the identification of alternatives, attributes and attribute levels. For the SCE, the description of the healthy office workplace will be transformed into a clear structure with tangible wording.

Alternatives

For each choice respondents make in the SCE, they do an observation of alternatives. In each choice set, two alternatives are included. Besides the alternatives, respondents can choose for an alternative that states 'no preference', meaning that the respondent is indifferent to the presented alternatives (Hensher, Rose, & Greene, 2005). In such a situation, the respondent does not have a preference between both alternatives.

Attributes

Chapter 2 describes the healthy office workplace through a categorization in aspects that are composed of multiple characteristics. In the experiment, the aspects are called attributes and their characteristics are called attribute levels. Each alternative contains all attributes, while the composition of the attribute levels differs per alternative. This composition can incorporate a mix of common as well as different levels.

Conform chapter 2, there are seven attributes that landlords can influence the enhancement of the healthy office workplace. One attribute is the 'indoor air quality' since the landlord decides on the type and dimensioning of the central ventilation system of the office building. Ventilation systems are able to treat and filter the air to improve the quality of the indoor air. Another attribute is 'thermal comfort'. This is influenced by the landlord through the type of HVAC installations that are applied in the office building. The impact of these installations on the temperature and its corresponding fluctuation of the temperature determine the comfort of the people that are using the office building. The 'exposure to light' is also an attribute that is influenced by the landlord, determined by the optimal balance of daylight and artificial light. The exposure to daylight is dependent on the arrangement of windows that provide daylight, the positioning of rental space to let daylight in and the type of window blinds. The exposure to artificial light is dependent on the quality and configurations of the indoor light infrastructure. Moreover, 'noise & acoustics' can be influenced by landlords through noise-blocking of external sound sources with acoustic insulation materials as well as noise alleviating of internal sound sources with application of acoustic absorbing materials. Furthermore, the landlord can provide flexibility to the tenants for their 'type of office' by the magnitude of adaptability of space layout through minimalizing the grid size and it's corresponding dimensioning of building systems. Although landlords have indirect influence the office type because tenants decide generally on the built-in of their office, they provide the extent of possibilities for tenants to arrange their office type. The attribute 'view' is also of influence, because the landlords decide on the location and orientation of the building towards green elements in the environment as well as the application of green elements in the plot of the office building or on walls and roofs that people inside the office have a view on. Last, 'provisions' that promote health that is programmed in the common space are of importance, which is acquired by the landlord when these belong to the office building complex. Because this research aims to determine the WTP for each attribute, an eighth attribute is added being the monetary component that is used to derive how much the WTP-attribute proportionate to each other attribute. This monetary component is stated as an assumption of the rental price as a factor of the current rental price that the organization of the respondent pays at the time of the completion of the questionnaire because each respondent has different lease conditions. This is because the sample consists of various tenants in different office buildings that vary in market rent. Furthermore, within a building, every tenant has another lease agreement with other rental price formations due to for instance differences in surface area or time of conclusion of the lease agreement.

Attribute levels

This research makes use of a multi-attribute approach, meaning that the outcomes are measured in different scales or units. In such situations, it is important that adequate (numerical) weights are determined for each attribute. In that way, trade-offs between attributes can be made (Peterson, 2009). To obtain preference weights from the SCE, each attribute consists of three attribute levels of ordinal qualitative scale what implies that the attribute levels are preserved for relative differences with the existence of natural order regarding health in the office workplace. The three attribute levels of each attribute are identified by characteristics that are applied in relatively a low health quality office, a medium health quality office and a high health quality office. *Attribute level labels* are assigned to attribute levels to represent the numerical or textual characteristics of the healthy workplace aspects that will be observed by the respondents. It is important that respondents "reasonably believe them to be feasible and the analyst has confidence in the shape of the utility expression outside of the empirically identified domain" (Hensher, Rose, & Greene, 2005). This implies that the scale of the attribute level labels is recognizable for respondents as well as the difference between them is distinguishable. All attribute level labels are displayed in table 3 below.

Table 3. Labels of attributes and attribute levels.

ATTRIBUTE	ATTRIBUTE LEVEL		
	Conventional office	Average office	Healthy office
Indoor Air Quality	Ventilation indoor-outdoor air	Ventilation with air treatment	Ventilation with air treatment and air filtering
Thermal comfort	Radiators + Airco-units (much comfort fluctuation)	Controlled system with comfort fluctuation	Balanced system with minor comfort fluctuation + Adjustable per space
Exposure to light	Standard window size + Standard light fittings	Standard window size with sun blinds + Light fittings with daylight correction	Large window size with adjustable sun blinds + Adjustable light fittings
Noise & Acoustics	No acoustic measurements	Acoustic insulation external sound sources	Acoustic insulation external & absorption internal sound sources
Office type	Open workfloor	Cell office	Flexible office
View	Only urban environment	Combination of urban and green elements	Fully green environment
Provisions	Reception + Standard (company) restaurant	Reception + Healthy (company) restaurant	Reception + Healthy (company) restaurant + Fitness + (Retail)services
Rental price	Current rent	Current rent + 5%	Current rent + 10%

The ordinal qualitative scale of the attribute levels differ per attribute and is formulated in a way that it complies with the level of understanding of decision makers of organizations' office workplace accommodation. For 'indoor air quality' this concerns the way the air in the office spaces is ventilated. A distinction is made in the implementation of air treatment (moisture and CO_2 concentration) and air filtering (extracting fine dust, odors, bacteria). 'Thermal comfort' is about the way the temperature in the office spaces is controlled. A distinction is made in system type, comfort fluctuation and adjustability. 'Exposure to light' differs is the amount and quality of light at a workstation. This influenced by window size, sun blinds and light fittings. 'Noise & Acoustics' varies in the reduction of noise through acoustic measures. This can be achieved by blocking noise from outside the office (traffic, building installations, etc.) as well as absorbing noise within the office space (footsteps, conversations, etc.). 'Office type' is distinguished in the layout/floor plan of the office spaces. An open workfloor has no walls; a cell office consists of enclosed spaces for max. 3 persons; a flexible office consists of different types of workplaces without a fixed workstation per employee. 'View' is specified by the degree of green elements in the view from the windows. Green elements can be applied in public spaces (trees, grass, etc.) as well as on the facades and roofs of the office building itself. 'Provisions' are distinguished by the presence of facilities in the office building. In addition to a reception and a (company) restaurant, these can also be facilities that encourage healthy nutrition and physical activity, stimulate social integration or reduce stress. At last, 'rental price' is the assumption of the rent of a square meter of office space.

Experimental design

The refined stimuli can now be used to set up the experimental design that includes the composition of alternatives, called *treatment combinations*. When applying a *full factorial design*, all possible treatment combinations are included. That amount can be calculated with the formula $I = L^H$, wherein I is the total number of alternatives, L the number of attribute levels and H the number of attributes. This gives $I = 3^8 = 6561$ alternatives. Nonetheless, the size of such design is not practical, can cause a cognitive burden on respondents and can create confoundment when treatment combinations do not differ enough. A respondent can only select one alternative per treatment combination, so it is important that each alternative consists of a pre-defined set of mutually exclusive alternatives meaning that the presented alternatives have clear distinctions from each other. When this is lacking, it is likely to influence response rate negatively which results in lower response reliability. To reduce the size of the design to avoid the mentioned deficiencies, a *fractional factorial design* is applied. This can be done through randomly selecting treatment combinations, but that is more likely to create a statistically inefficient design. To scientifically select the optimal use of treatment combinations, an *orthogonal*

design is used. This requires that all attributes are statistically independent of another which implies that there is zero correlation between them. Practically, this means that each possible pair of attribute levels appear an equal number of times in the design, which is validated with a regression analysis that is performed between attribute columns. To find the optimal use of treatment combinations, this research made use of a predefined fractional factorial design according to a masterplan that is selected with the combination of the number of attributes and the number of attribute levels. The combination of 8 different attributes with 3 attribute levels each corresponds with a matrix that includes an optimal combination of alternatives. This matrix is given in appendix A.

The matrix indicates that the experimental plan requires 27 alternatives, also called *profiles*. A rule of thumb is that at least 30 observations per profile are needed to generate proper data for analysis. This means that a total of 27 x 30 = 810 profile observations are needed. It is chosen to not let every respondent observe all 27 profiles because this number is rather much for keeping a respondent's attention during the whole questionnaire. Because respondents are showed eight attributes per observation, there is chosen to show only two profiles per observation to keep the focus of respondents. This means that at least 810 / 2 = 405 profile observations must be made. In order to find an integer amount of profile observations per respondent, it is chosen to include nine treatment combinations (choice sets) per questionnaire. That requires at least 45 respondents to fill in the questionnaire (405 / 9 = 45). To distinguish groups in the results, roughly a double amount of tests are needed, requiring roughly 100 respondents.

Because each respondent does not observe every profile, the allocation of all treatment combinations must be programmed in a way it diminishes bias and dominance. This is done by randomly assigning all 27 different profiles to respondents in the programming. One condition is that one profile cannot be observed with a duplicate profile in one treatment combination which implies that a correction is made when the left and the right profile are equal through random assignation. An example of a treatment combination is given in figure 3, with on the left profile #12 and right profile #23. For each treatment combination, the respondent gets the task to always choose which imaginary office workplace they prefer. If they cannot weigh up or do not prefer both choices, they are asked to choose 'No preference'.

ASPECTS	Workplace 1	Workplace 2	No Preference
Indoor Air Quality	Ventilation with air treatment	Ventilation with air treatment and air filtering	
Thermal comfort	Radiators + Airco-units (much comfort fluctuation)	Controlled system with comfort fluctuation	
Exposure to light	Large window size with adjustable sun blinds + Adjustable light fittings	Standard window size with sun blinds + Light fittings with daylight correction	
Noise & Acoustics	No acoustic measurements	No acoustic measurements	
Office type	Open workfloor	Cell office	
View	Fully green environment	Fully green environment	
Provisions	Reception + Standard (company) restaurant	Reception + Healthy (company) restaurant + Fitness + (Retail)services	
Rental price	Current rent + 10%	Current rent	
CHOICE	O	O	O

Figure 3. Example treatment combination with profile 12 and profile 23.

The experimental design that is generated conform to the described method is applied in the survey instrument. The survey instrument is made as an online questionnaire because this is the most accurate way to approach the respondents of which a contact list with email addresses of decision makers of office tenancy that is provided by the organization of the CBRE Dutch Office Fund with whom this research has been conducted in collaboration. Moreover, the survey instrument provides a quicker data collection of the required data and needs less time for data preparation. The online questionnaire is developed in the Berg Enquête System (Jessurun, 2007). This system is able to combine rather simple questions (e.g. open and closed questions) with a choice experiment that follows a predefined design. In order to increase the range of potential respondents, the survey is provided in Dutch and English. In the survey instrument, the first part examines the aspects that influence decision making of organizations about their office workplace accommodation. The second part includes the SCE with the healthy office workplace attributes and attribute levels that are identified in the previous sections. The full format of the questionnaire can be found in appendix B. The structure of the questionnaire will be described in this section.

Introduction and Data protection statement
The receivers of the email with the invitation to participate in the research could enter the online questionnaire via a hyperlink that was provided in the email. The questionnaire starts with a screen with a short introduction text. When respondents continued, a data protection statement followed in the next screen which they had to accept to be admitted to the rest of the questionnaire. When respondents did not accept, the questionnaire was terminated since it is not legally permitted to use data of people that do not participate voluntarily. When respondents accepted, they continued with the questions about their personal background.

Personal background
Because this research focuses on tenants, the demographic statistics of respondents are not needed to be described in detail. Therefore, the personal background of respondents is tested with three characteristics. First, the gender distribution is examined as an indicator of the homogeneity of the sample. Second, the age of respondents is identified by categories to test for homogeneity of the sample as well as to possibly identify whether specific age groups or generations have a different view on the healthy office workplace. Third, respondents had to fill in to which extent they influence the decision making of the real estate accommodation of their organization. This information can gain insight into the possibility that people that have more influence in decision making of the real estate accommodation of their organization may have other awareness of health in the workplace or are willingness to pay different rent for it. Besides, this question does not only function for the purpose to identify the extent of authority in decision making, but also to eliminate people that do not have influence. When respondents state to not have any influence, the questionnaire was terminated since they do not fit in the scope of this research. Otherwise, questions about organizational characteristics followed.

Organizational characteristics
The organizational characteristics consist of the variables that are identified in chapter 3 of this thesis, being information about the organizations where the respondents work. These characteristics are identified by a set of questions that are grouped in the part of the organization that rent office space in the current office and a set of questions that are grouped in the context of the organization as a whole. All questions enable to find whether the willingness to pay of desired levels of healthy office workplace aspects is different subject to different characteristics of an organization.
The questions that focus on the current office are set up to identify in which office building the tenant leases office space, what the type of lease is, how many workers make use of the leased space as well as that relates to the total organization, and which focus values and goals fit to the lease of the current office space. First, it is questioned in which office building there is leased. With this information, it is able to figure out with help of knowledge of the CBRE Dutch Office Fund in which city the organization is renting, how many tenants there are leasing in total in that office building and how many office space is leased via the serviced office provider. This is possible since the answer-options are expressed in the names of the office buildings that are part of the CBRE Dutch Office Fund. Second, it is questioned whether the tenant leases directly from the landlord or via the serviced office provider to determine the type of lease and so the type of business center concept. Based on section 3.3, only two concepts of business centers are relevant in this research because those are present in the sample. This is because the CBRE Dutch Office Fund focuses on prime locations that are generally too expensive for co-working offices and incubators. The relevant concepts are the regular business center and the serviced office. Both concepts are entwined in almost every building in which the tenants in the sample are currently renting. This is because there is a serviced office provider renting (The Office Operators - TOO) from the landlord and sub-leasing office space and providing services in their rented space to third parties. Third, two questions about the size of the organization are asked of which one to identify how many workers make use of the leased space expressed in the full-time equivalent (FTE) of employment and another how this relates to

percentages to the whole organization. The ordinal scales of possible answers are based on the scales that the Centraal Bureau voor de Statistiek (CBS) handles (CBS, 2019). Fourth, in order to track down for which capacity organizations prefer to do interventions in their rented office workplaces, a question is asked about which focus value of the ones that are identified in section 3.2 fits the most to the part of the organization that uses the current office building. A similar question is asked about the goals that are identified in section 3.2 to understand their strategies regarding office tenancy, but for that question respondents were able to select multiple answers.

General questions about the organization as a whole concern the organizations' primary activity, maturity and policies&strategies regarding workers' health. The primary activity is tested by asking the contemporary SBI-classification (Standaard Bedrijfsindeling) of the Centraal Bureau voor de Statistiek (CBS), which is displayed in appendix C. For the maturity it is logical to include the development phase of an organization in the questionnaire conform the three main phases of spatial allocation that are identified in section 3.2. The levels are concisely described with phase (starting, growing, mature) with a brief description and a corresponding age range.

In order to identify whether respondents' organizations have awareness of workers' health relevance, the questionnaire must contain a question that mentions the presence of a policy or strategy towards workers' health and why they do have or do not have. Therefore, the status of the current awareness is triangulated by asking whether the organizations have health policies of strategies or not. If the organization reports that there is such policy or strategy within the organization, there will be asked what kind of interventions the organization takes to promote the health of their workers. If the respondent reported that there is no health policy or strategy within the organization, there is asked why it is missing. The presented answer possibilities concerning the kind of initiatives to promote health of workers are redefined through adding some examples conform the study of Baicker, Cutler & Song (2010) in appendix D and the answer possibilities with motivations not to have a health policy or strategy are redefined in appendix E on basis of the survey of Buck Consultants by Xerox Corporation (2014).

Building factors

In order to determine which characteristics of healthy office workplace aspects the tenants currently possess, they are asked to select the current state of those aspects within their office as a kind of revealed preference. The states of which the respondent can choose are the same as the possible states in the hypothetical quantitative test in the questionnaire. Before respondents are performing the stated choice experiment, they get a question about their opinion towards the condition of the office the organization is currently renting. This question contains the same answer options as the different attribute levels that are included in the SCE (table 3), complemented with the answer option 'None' if no characteristic applies. Only one option can be selected per attribute. This question has three functions: (1) to compare how respondents rate their current rented office to the actual situation, (2) to reveal how respondents rate their current rented office in order to compare their preference for healthy office workplace characteristics of the SCE with their current experience so it may uncover if a low current state is related to a higher demand for a better state or vice versa and (3) to get used to the attribute levels that will follow in the remaining questions. The respondents are able to read extended information about the attributes with a mouseover hover text if they do not completely understand them.

In this study, non-health related building factors (within the influence of the landlord) are left out of consideration since they can overlap the office concept as well as the healthy office workplace characteristics that are examined in the questionnaire. Such overlap results in confusion and demotivation of respondents that may influence the reliability and thee response rate questionnaire negatively. To maintain the sensitivity of the preferences of healthy office workplace aspects, respondents will be asked not to consider other building aspects in their choices.

Location characteristics

The questionnaire will also not include location characteristics because the target population of this research is already focused on specific locations, namely tenants on prime office locations in big cities in the Netherlands. Therefore, respondents will be asked not to consider the locational aspects of the choices they make in the questionnaire.

Rental price

The rental price is considered in the questionnaire as part of the quantitative test. In chapter 4 there is described how the rental price provides useful information that contributes to the object of this research.

<u>Stated choice experiment</u>
The last part of the questionnaire is the main experiment, consisting of the treatment combinations that are presented to the respondent. As elaborated earlier, each respondent gets nine choice tasks with a treatment combination that consists of two randomized profiles and the 'No preference' option as shown in the example of a treatment combination in figure 3. Respondents are asked which imaginary office workplace has their preference (see questionnaire in appendix B). Again, if they want to read more information about an attribute, they can move their mouse over that aspect.

Willingness to Pay

"WTP measures are calculated as the ratios of two parameters, and as such are sensitive to the attribute level ranges used in the estimation of both parameters" (Hensher, Rose, & Greene, 2005, p. 464). This means the willingness to pay is calculated for the utility difference between two parameters of an attribute, so an utility win or loss. Because the sample of this research include tenants that all pay other rental prices per square meter office space, they are asked to rate the hypothetical rental price as a percentual factor of their current rental price. In the WTP-calculations, this means that this percentual factor must be incorporated in the calculation of the ratios between the two parameters. For instance, when the multinomial model estimates a positive utility difference of 0.300 from one attribute level to another attribute level of a particular attribute as well as the model estimates a positive utility difference of 0.120 between two attribute levels of the WTP-attribute that represent a +15% price increase, the willingness to pay for the utility win for the particular attribute is 0.375% (=0.300/0.120 * 15%). Because this study includes three WTP attribute levels that are submitted to the respondents during the experiment (see stimuli refinement of attribute levels in previous section), being respectively 'Current rent', 'Current rent + 5%' and 'Current rent + 10%', their multiplying factors are 5% for the utility difference from the first to the second or the second to the third attribute level of the WTP-attribute and 10% for the first to the third attribute level of the WTP-attribute.
Furthermore, "In calculating a measure of WTP, it is important that both attributes to be used in the calculation are found to be statistically significant, otherwise no meaningful WTP measure can be established" (Hensher, Rose, & Greene, 2005, p. 464). This means that it is not possible to calculate a WTP measure for attributes that have zero significant attribute levels.

In this study, the willingness to pay is calculated for the utility difference between two attribute levels of a particular attribute and the rental price attribute. Unfortunately, these cannot be incorporated into one WTP-value. Therefore, the best of each three WTP-values can be chosen for further analysis. From these values, the utility difference of the rental price from 0% to 10% seems the most suitable since it covers the ranges (not the estimates) of both other attribute levels (the other two attribute level labels have quantitative values with a linear gradient). Nonetheless, there is a way to incorporate all three values into one WTP-factor since all attribute levels contain a quantitative value. This integration must be done in the dataset before estimating the MNL-model. Therefore the price values must be coded for the WTP-attribute levels in the dataset as 0, 5 and 10 (see table 7, section 5.2)

4.4 INTERNAL VALIDITY, EXTERNAL VALIDITY AND RELIABILITY
The results that will be found with this explorative research can be discussed in their reliance on several factors outside their methodology. Therefore it is meaningful to discuss the validity of this research that can be distinguished in internal validity and external validity. For the same reason, the reliability is also discussed

The *internal validity* discusses whether the research actually measures what is intended to be measured. In this research, the internal validity considers whether the respondents made choices in the SCE in a similar way as they would do in real life. For this methodology that is determined by multiple factors that may influence the parameters of the MNL and LC models. At first, the SCE contains hypothetical choice situations wherein respondents are requested not to mention influences that are not included in the choice situations (ceteris paribus). That does not exclude that respondents will not consider other influences at all. For example, some respondents keep in mind the push, pull and keep factors that were left out of consideration. Also, this study only included healthy office workplace aspects that can be influenced by landlords. Nonetheless, the healthy office workplace aspects that tenants themselves apply in the lettable area can influence preference as well. Moreover, it is not certain whether respondents will choose for the exact application of the provided attribute levels in real life since the attribute levels are mostly qualitative indications. But also for the WTP-attribute it is not sure whether people pay the hypothetical price in real. In general, the judgment of respondents during the SCE can be dependent on the mood, time and place of responding.
Furthermore, potential misinterpretations and losses of attention can also influence the parameters of the MNL and LC models that might be the reasons why the attribute levels of an attribute will be insignificant. These can be caused by decisions that are made during the design of the experiment. It is possible that the stimuli

refinement of the attribute level labels is too long. Especially because every treatment combination contains 18 attribute levels (two alternatives with eight attribute levels each), respondents may lose their attention during the nine choice situations of the SCE. Attention losses during the SCE may also lead to the use of the 'no preference' option while the respondent has a preference for an alternative. Although the respondents will answer all the choice tasks with 'no preference' will be filtered out, some might use the 'no preference' option due to disinterest at some choice tasks. It is also possible that some respondents misinterpreted some attribute level labels because they were too comprehensive for them, although the explanation was possible via the mouseover hover.

The sequence of the questionnaire can be another point of discussion. However the sequence of questions is deliberately chosen, it is possible that some respondents will not finish the questionnaire because they lose attention due to feelings that they make no progression. Maybe an opposite sequence could decrease the number of unfinished questionnaires. When putting advanced questions first, it might costs respondents less effort to finish with the simple questions. Contrary, the simple questions might 'warm-up' respondents to proceed with the questionnaire. Since respondents do not know what to expect subsequently, there is chosen to 'warm-up' so people may have more spur to finish the questionnaire.

At last, it is not sure whether all respondents are decision makers of their organizations' office workplace accommodation, although the questionnaire includes a question to filter out respondents that did not influence decision making. If respondents do not have influence but pass the filter question, their answers are not measuring what is intended to measure.

The *external validity* discusses the degree to which the results can be generalized to the wider population, cases or situations. It discusses the representativeness of the focus of this research, being all tenants of the CBRE Dutch Office Fund that were invited to the questionnaire. The survey's response rate can influence the external validity of the results, being the number of people who completed the survey divided by the total number of people that were entitled to participate. A low response rate can cause the absence or inequality of some distinctive groups of respondents that should form an important share of the sample. A similar relation exists for the total number of respondents, which influences the external validity negatively when the number is rather low and so might influence for instance the significance levels for the MNL model, LC models and Chi-Square tests as well as the number of latent classes.

When generalizing the sample to the focus of this research, being multi-tenant business centers on prime office locations in big cities of the Netherlands, the external validity is influenced by a probably larger variability of the sample that consists of a probably larger variety of tenants in a bigger diversity of office buildings. That is because tenants in other office buildings on the same locations possibly have other preferences than the tenants of the CBRE Dutch Office Fund that formed the sample of this research.

The *reliability* discusses whether significant results will be similar when the study will be repeated. This means that when the conditions are exactly the same, the results will be identical. Nonetheless, that cannot be ruled out completely for this experiment. Mainly behavioral and environmental factors of respondents such as the mood, time and place of responding may lead to different execution of the SCE. Furthermore, it is possible that another amount and other types of respondents fill in the questionnaire when repeating since just a part of all people that received an invitation to participate in the research probably complete the questionnaire. When repeating the experiment, this may lead to other combinations of answers and another response rate. Besides, different assignation of treatment combinations to respondents can lead to other considerations of respondents that can influence model parameters since the assignation is randomized.

4.5 CONCLUSION

The Stated Choice Experiment (SCE) is selected as the most suitable methodology to investigate which healthy office workplace attributes are of interest by office tenants, to identify trade-offs between attributes and attribute levels and to estimate the Willingness to Pay (WTP) for attributes and attribute levels. The SCE is based on the Random Utility theory that assumes that respondents always choose the alternative that maximizes their utility. The utility in this study is based on the preference for attributes and attribute levels, that are allocated in alternatives. Preference parameters can be estimated with the use of a Multinomial Logit (MNL) model and preferences of group segments within the sample can be estimated with Latent Class (LC) models. The stimuli of the SCE are refined with two alternatives per choice set are included as well as an alternative that states 'no preference'. Each alternative contains seven healthy office workplace attributes together with an eight WTP-attribute. The attribute levels follow ordinal qualitative scales that are relatively applied in a low, medium and high health quality office (table 3). A fractional factorial experimental design of 27 alternatives is applied based on an orthogonal design. Each respondent has presented nine treatment combinations whose allocation is based on diminishing bias and dominance. The survey instrument is constructed in an online questionnaire that includes the SCE as well as questions that identify characteristics of the respondents' background regarding the decision making of their organizations' office workplace accommodation.

5. DATA ANALYSIS AND RESULTS

This chapter outlines the analyses of the data that is collected with the survey including the Stated Choice Experiment. It provides information about how the data is collected, in which ways the data is prepared for analysis and what the descriptive statistics are (including independencies). Subsequently, the data of the Stated Choice Experiment are analyzed by means of the Multinomial Logit model and Latent Class models.

5.1 DATA COLLECTION

As described in chapter 4, this research used a web-based questionnaire to collect data from respondents. This was done via an email distribution among approximately 550 tenants that lease office space in The Netherlands from the CBRE Dutch Office Fund that determined the sample of this research. This number is an assumption since it is possible that some email addresses were invalid or not in use anymore because for instance decision makers switched from a job. Also some respondents were approached via mailing lists of third parties such as property managers and the serviced office operator of which number of receivers is unknown. The data is collected from the period between the 28th of May 2019 to the 5th of July 2019, wherein a reminder was sent to all tenants after 1.5 weeks after the initial email. In total, the data of 84 respondents is usable for analysis of which 68 respondents completed the Dutch questionnaire and 16 respondents completed the English version.

Tenants were invited to participate in the research via an email which is included in appendix F. The email consisted of a short introduction of the research with a hyperlink that redirects to the web-based questionnaire. When the receivers of the email followed the hyperlink, they started in the home screen of the questionnaire where a brief explanation of the questionnaire was given followed by a privacy declaration. When a respondent accepted the privacy declaration they were redirected to the next screen in which the respondents were questioned to what extent they can influence the decision making of the real estate accommodation of their organization. When respondents answered to not have influence, the questionnaire was ended. In total, 57 respondents were excluded from the questionnaire because they did not have influence and thus did not fit in the scope of this research since it needs respondents to be decision makers of office accommodation. The remaining respondents formed a total of 108 respondents that continued the questionnaire of which 84 valid data was generated.

5.2 DATA PREPARATION

The collected data need to be prepared in order to create a dataset that can be used for data analysis. The data can be distinguished in two main types, being dependent variables and independent variables. The dependent variables are the healthy office workplace attributes that are identified in chapter 2. The independent variables in this research are the socioeconomics (SECs) of which variables identified in chapter 3. To perform data analysis, three software programs are used. Descriptive statistics of independent and dependent variables are conducted with the use of IBM SPSS Statistics Version 25. For the estimation of the Multinomial Logit model and Latent Class models, NLogit 5 is used since it is the most suitable software package for estimating discrete choice models (Greene, 2012). Furthermore, Microsoft Excel is used for follow-up calculations and chart generations.

Before analyzing the definitive data, the raw data of both dependent variables and independent variables is edited into a form that can accurately be analyzed. One action is performed concerning the whole dataset:

- Deleted cases: Although all questions were programmed in the BERG-system as obligatory to complete the questionnaire, some questions remained unanswered. This occurred when respondents terminated the questionnaire before completing it. These unanswered questions left corresponding variables behind with missing values. All cases with missing values due to uncomplete questionnaires were deleted, concerning a total of 22 respondents. Among this amount, nine respondents terminated the questionnaire in the SCE part and six respondents terminated the questionnaire at the revealed choice questions. The resting seven terminations differ per question. After deleting cases due to unanswered questions, 86 respondents were left for further data preparation.

Subsequently, some values of independent variables are prepared by the following actions:

- Missing values: Because the questionnaire only included obligatory questions, there was no possibility that missing values were present in the dataset. Nonetheless, a few answers are recoded as missing values. That was done when respondents did fill in a textual answer that was useless or irrelevant at the questions that asked about measures the organization takes to promote the health among their workers or the questions that asked why there is no health policy or strategy within the organization. Useless or irrelevant answers were recoded into '-999', because that number is generally used in NLogit for missing values. Missing values were not included in the analysis.

- Recoding textual values: Besides recoding textual answers into missing values, other textual answers were recoded into existing values. Textual answers were allocated to existing values when those were comparable to other answer possibilities of the same question. For the question about measures the organization takes to promote the health, this applied to two answers that comply with 'Added incentives for participation', namely textual answers about employee insurance and providing free healthy food in the office. For the question about why there is no health policy or strategy within the organization, two answers are recoded into the value of 'Insufficient management support' since the answer considered that the organization is too small (yet). There were no new values created based on textual answers because all textual answers were rejected and recoded as missing value or allocated to existing values through recoding to that values.
- Recoding values: Two values of the variable 'FTE related to total organization' are merged into one value since there was probably some confusion between the two values in the questionnaire. This concerned the values '75-100%' and '100%', where values or '100%' are recoded into '75-100%'. This is done because both values overlap and only two respondents answered with '75-100%'.
- Recoding variable labels: Other independent variables were recoded into forms that provide a better understanding of the analysis instead of an easy interpretation of respondents. This considered the values of the variable 'type of lease'. In the questionnaire, it was asked whether respondents their organization lease office space directly from the landlord, via the serviced office provider (The Office Operators - TOO) or if they don't know. The answer 'Owner (landlord)' is recoded into 'Regular business center (Direct lease)', 'The Office Operators (TOO)' into 'Serviced office (Indirect lease)' and 'Other / I don't know' into 'Unknown'.

  Also, the question about which office building the organization lease office space is recoded, but the existing answers are also maintained. In addition an extra variable is created that concerns values of city names wherein the office buildings are located, since this is known based on the office building names. So, the variable 'Location' with the values 'Amsterdam', 'Schiphol', 'Utrecht' and 'Rotterdam' is added.

The sub dataset with all dependent variables is prepared by the following actions:
- Deleted cases: Among the 86 respondents that were left, the data of two respondents were deleted because they both answered all SCE questions with 'No preference'. This indicates that these respondents did not take the questionnaire seriously and thus did not provide trustworthy evidence.
- Recoding alternatives: In order to perform statistical tests, the software NLogit has some restrictions on the format of data. Therefore, the choice sets needed to be transformed from the experimental design to a format that was able to read by NLogit. Hence, the data of one respondent is divided into nine blocks that each refers to a choice set. One block contains three rows that each corresponds to an alternative within that choice set (one choice set contains two alternatives and an alternative that states 'no preference'). In total 2,268 (= 84 respondents * 9 choice sets * 3 (2 alternatives and 1 no choice option)) data rows are created for analysis of the SCE.
- Recoding choices: Because all alternatives are recoded into blocks, it must still be clear which alternative is chosen. Therefore, the chosen alternative is recoded with 1 and the others with 0.
- Recoding attribute levels: In order to create a dataset that can be analyzed with NLogit, effect coding is applied to derive utilities of attribute levels. Therefore, the eight attributes with the corresponding 24 attribute levels as stated of table 3 are encrypted as follows (see Appendix G):
  - Attribute level 0 (low health quality office): 1 0;
  - Attribute level 1 (medium health quality office): 0 1;
  - Attribute level 2 (high health quality office): -1 -1.

  In this way, the part-worth utility of each attribute level can be estimated because the base level receives a value of minus one (-1). That produces an unique utility that does not include linear coding (Hensher, Rose, & Greene, Applied choice analysis: a primer, 2005). Since every attribute consists of three attribute levels, the part-worth utility of attribute level 0 of the first attribute is equal to β_1, the second attribute level to β_2, the third attribute level to $-(\beta_1+\beta_2)$, and so on. The utility of the 'no preference' option is estimated by the constant β_0 and encrypted with 0 0.
- Recoding attribute levels: Instead of effect coding, the rental price is coded in one column instead of two (see table 4), which results in one coefficient of the WTP attribute in the new MNL model estimate.

Table 4. 'Rental price'-attribute from Effect coding to WTP coding

Attribute	Attribute level	Effect Coding		WTP Coding
	Current rent	1	0	0
Rental price	Current rent + 5%	0	1	5
	Current rent + 10%	-1	-1	10

5.3 DESCRIPTIVE STATISTICS

The description of the sample is given in this section through statistics of the independent variables, being the socioeconomics of the respondents, but particularly of the organizations where they work. First, the base demographic statistics of the respondents are given and compared to the study population. Hereafter, the statistics of the organizational characteristics are specified, including a current organizational focus on health. Some statistics were able to compare with the study population and the panel. Subsequently, both the demographic statistics and the organizational characteristics are examined for correlations between characteristics.

Personal background

As mentioned in section 4.1, limited personal demographic statistics of respondents are identified since the research focusses on the tenants' view on organizational level. That is why only respondents' gender, age and influence the decision making of the real estate accommodation of their organization are asked. The numbers of the personal background are not compared to statistics of other populations because there are not such generic numbers available that are adequate to compare with this sample.

Gender

Figure 4 shows the percentages for gender. From all 84 respondents, the gender distribution is nearly equal with 47.6% males and 51.2% females. Moreover, one respondent did not want to provide an answer to what equals the remaining 1.2%.

Age

The distribution of age is displayed in figure 5. The biggest share of respondents belongs to the 'average' age group of 30-49 years old (53.6%). Furthermore, it shows that 16.7% of respondents are relatively younger workers and 39.8% are relatively older worker of which 3.6% more than 65 years. In the questionnaire, also the value '<17 years' was given to be sure the whole sample could be covered. As expected, no respondents chose this value so it is left out of consideration in the descriptive statistics.

Decision making of real estate accommodation

Figure 6 includes the distribution of respondents' extent of influence on decision making of their organizations' real estate accommodation. It provides insight into the extent of authority of respondents within their organizations which can influence awareness of workplace trends that determine preferences. Most of the people are responsible for making decisions of which some alone (10.7%) but more with others (51.2%). The resting 38.1% of respondents are not responsible for decisions about real estate accommodation but can influence the decisions that are taken by others.
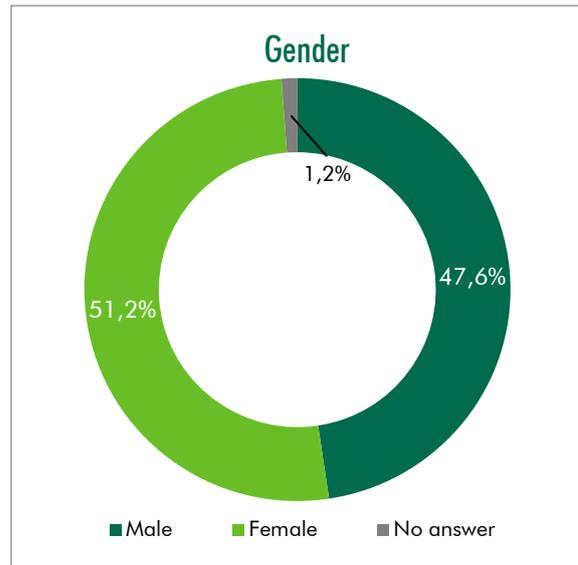

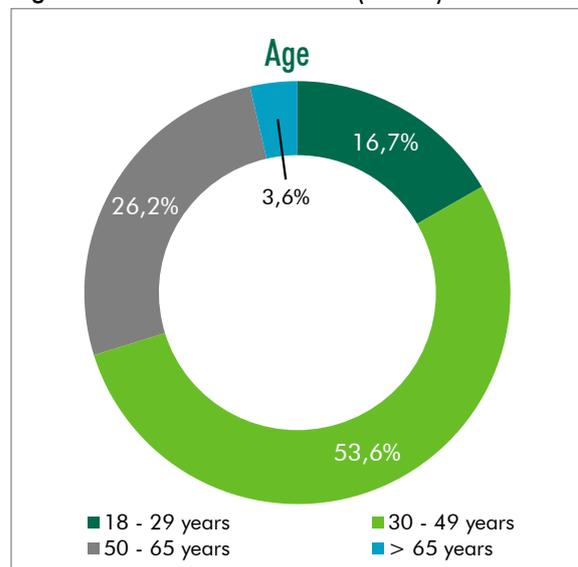**Figure 4. Gender distribution (N=84)**

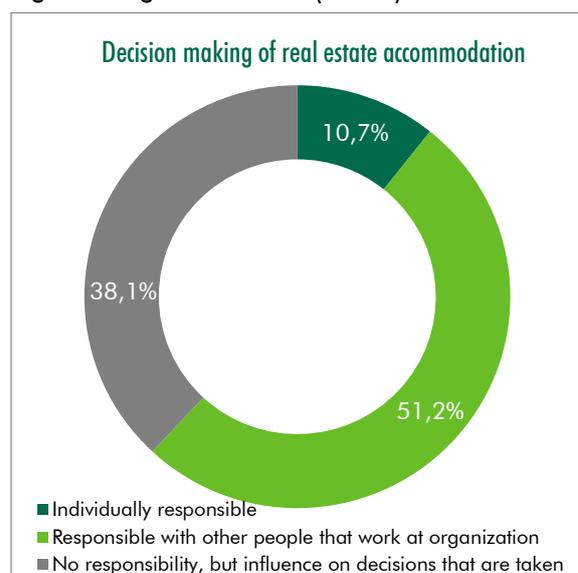**Figure 5. Age distribution (N=84)**

Figure 6. Distribution of Decision making of real estate accommodation (N=84)

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Relationships between demographic characteristics

Chi-square tests of independence were performed to examine the relations between gender, age and decision making. To fulfill the needs that no more than 20% of the expected count is less than five and the minimum expected count is at least one (McHugh, 2013), the person that did not provide an answer on gender is not taken into consideration in the execution of the chi-square tests. Furthermore, the '>65 years' age group is merged with the '50-65 years' age group and responsibility of decision makers 'individually' and 'with other people' are merged.

The relation between gender and age was insignificant, χ^2 (2, N = 83) = 4.793, p>0.05, meaning that the distribution of age did not differ by gender. Also, the relation between age and decision making was insignificant, χ^2 (2, N = 84) = 1.011, p>0.05, meaning that the distributions of both variables did not differ by the other. The responsibility for or influence in decision making of real estate accommodation did, however, differ by gender, χ^2 (1, N = 83) = 5.988, p<0.05 since the relationship was significant. The differences show that males do more often have responsibility for decision making than females, but among females the distribution between responsibility and influence is almost equal.

Organizational characteristics

Besides demographic statistics of respondents, information about the organizations where the respondents work is retrieved. The identification of these characteristics is described in chapter 3 of which the relevant selection given in the survey instrument description in paragraph 4.3.

Office building & Location

The office building in which the (part of) organization is currently leasing from the CBRE Dutch Office Fund is identified in the questionnaire. Besides this distribution provides information of the sample that can be compared with the target population of this research, it is also used to determine the distribution of cities in which the organizations of the respondents are (partly) established. This resulted in the distributions as displayed in figure 7.
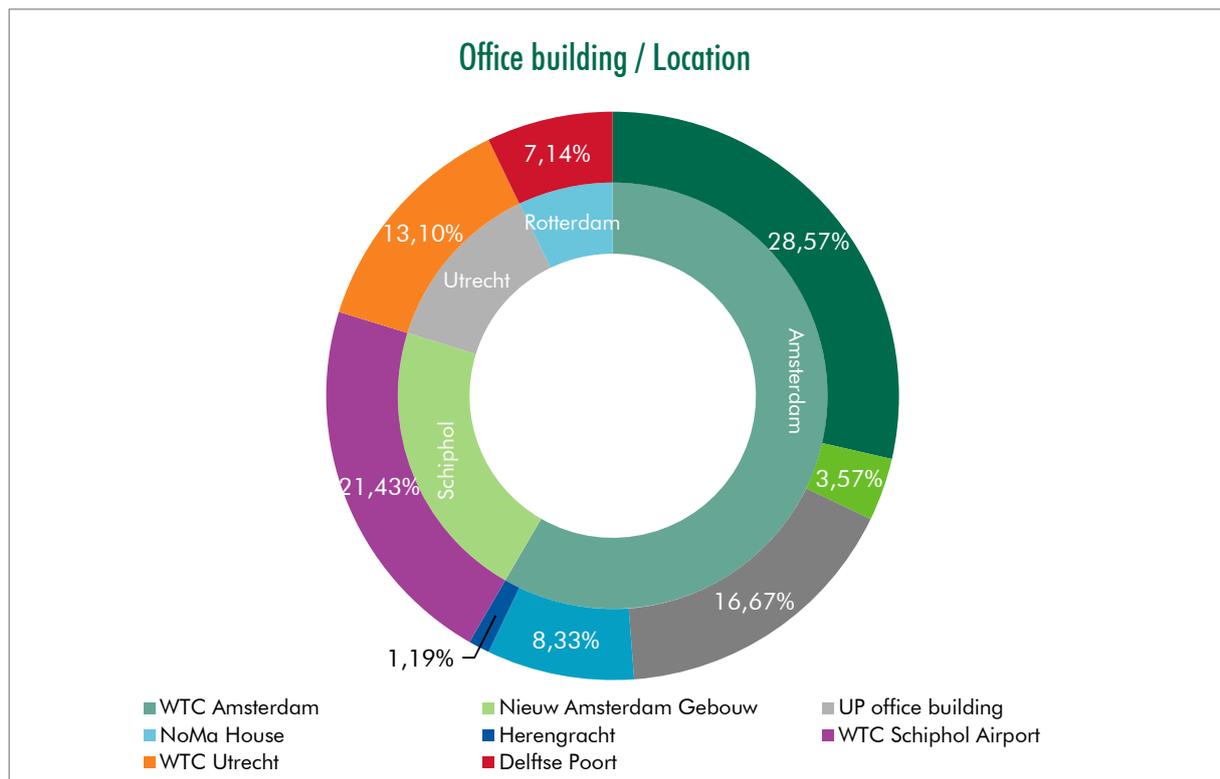

Office building / Location

Rotterdam 7,14%
Utrecht 13,10%
Schiphol 21,43%
Amsterdam 28,57%
3,57%
16,67%
8,33%
1,19%

- ■ WTC Amsterdam
- ■ Nieuw Amsterdam Gebouw
- ■ UP office building
- ■ NoMa House
- ■ Herengracht
- ■ WTC Schiphol Airport
- ■ WTC Utrecht
- ■ Delftse Poort

Figure 7. Distribution of office buildings and location (N=84)

In the figure above, two values are left out of consideration since both were not chosen by respondents. The nonresponse can be explained by a relatively low amount of tenants in those buildings. In general, the percentages are slightly related to the city coverage in the same reporting period of the CBRE Dutch Office Fund.

Business center concept (Type of lease)

The statistics that provide information about whether tenants are leasing from the regular business center or the serviced office are shown in figure 8. The statistics from the landlord of the sample show 6.5% (financial occupancy) allocation to the serviced office operator in the same period. This means the number of respondents deviates from the total sample.

Size of the organization

The size of an organization is measured on the full-time equivalent (FTE) of employment which is approached on two levels. On the one hand, the absolute amount of FTE is identified per organization that uses office space in the office buildings of which respondents were sampled (figure 9). On the other hand, statistics were derived about the proportion of that FTE (in percentages) towards the total organization (figure 10).

The amount of FTE in the office buildings in for the majority of this sample relatively small: 42.9% of the organizations only put 0-10 FTE in the concerning office and 23.8% about 10-20 FTE. Larger amounts were less represented with 14.3% of the organizations that lease office space for 20-50 FTE, 8.33% of the organizations that lease 50-100 FTE and 10.71% that lease >100 FTE. Nonetheless, when organization put more FTE in an office space, they lease in general more office space. That probably levels out this distribution when this was set out in lettable floor area (LFA). Nonetheless, the statistics indicate that the sample includes more small tenants than big tenants.

The proportion of FTE related to the total organization is for 44% determined by a minority of the total organization (< 25%), 17.9% by a substantial part of the total organization (25-75%), 38.1% by (almost) the whole organization (75-100%). This indicates that for most respondents in this sample, only a part of their organizations is leasing office space that concerns the buildings in this sample.

Purpose of accommodation

The distribution of goals that serve for (the part of) respondents' organizations as a starting point for choosing the office building is displayed in figure 11. Because each respondent could answer with multiple answers, the amount of each answer is plotted against the total number of answers and sorted from the most to the less given answer.

The promotion of marketing and sales was important to many of the respondents' organizations, followed by their employee satisfaction. Thereafter, cost efficiency and productivity were found to be important for some organizations of respondents. Stimulating innovation sustainability, and flexibility of the rental agreement were found to be less important for leasing the current office space in the buildings in the sample. These statistics indicate that the human component is the most important for organizations, but tangible economic components are also taken into account. More progressive components were less mentioned.
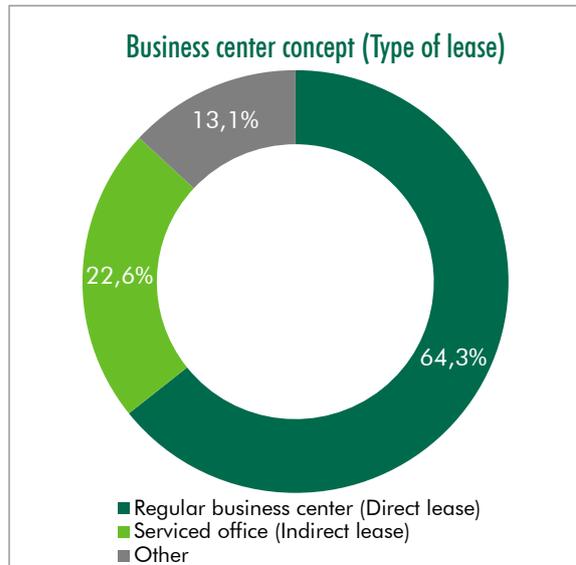

Figure 8. Distribution of business center concept and type of lease (N=84)
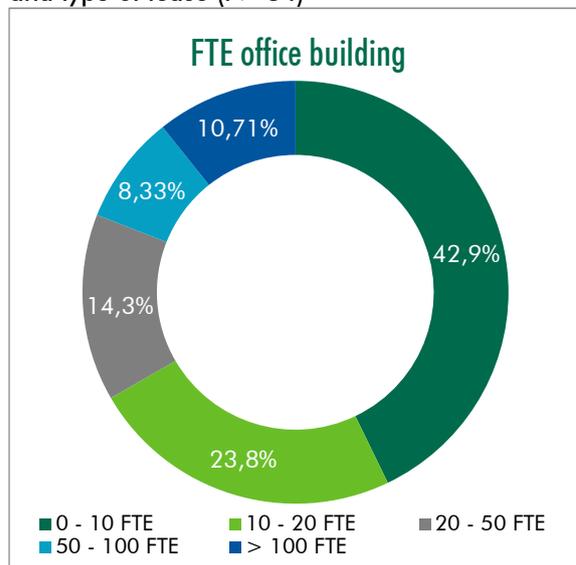

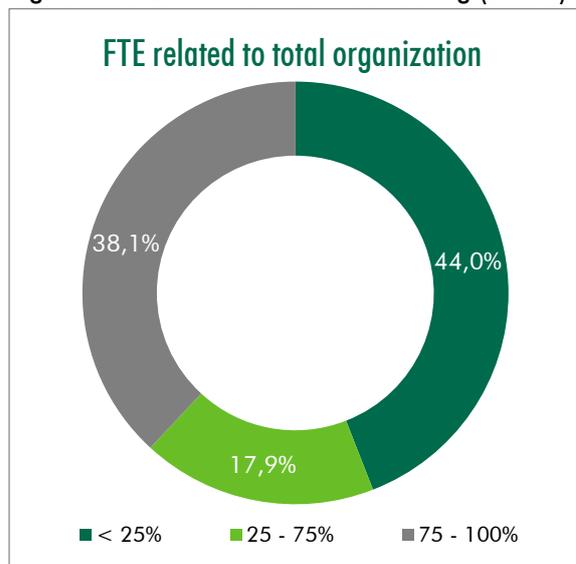Figure 9. FTE distribution office building (N=84)

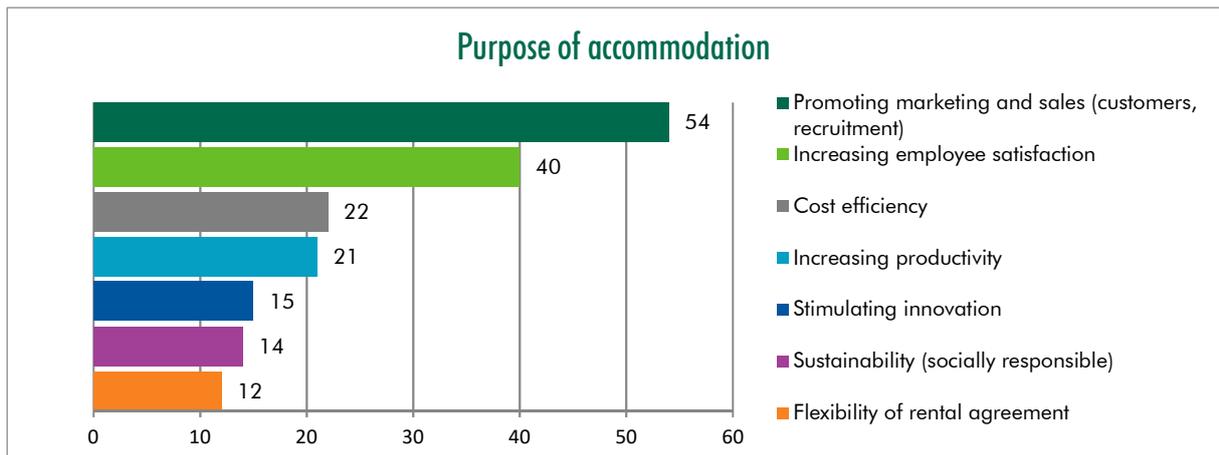Figure 10. FTE distribution regarding whole organization (N=84)

Figure 11. Distribution of purpose to accommodate in current office (N=84)

Primary activity

Figure 12 depicts the distribution of business sectors where the organizations of the respondents are active in. Four initiated sectors were left out of consideration since there were not present in the sample. The other sectors indicate that financial institutions (29.8%) are represented the most. Consultancy, research, legal and other specialized business services (15.5%) as well as other service activities (14.3%) were represented much in the sample as well. Moreover, organizations with information and communication activities are in the sample for 9.5%. These percentages indicate that the sample is mainly represented by different types of service firms and partly by IT related companies.
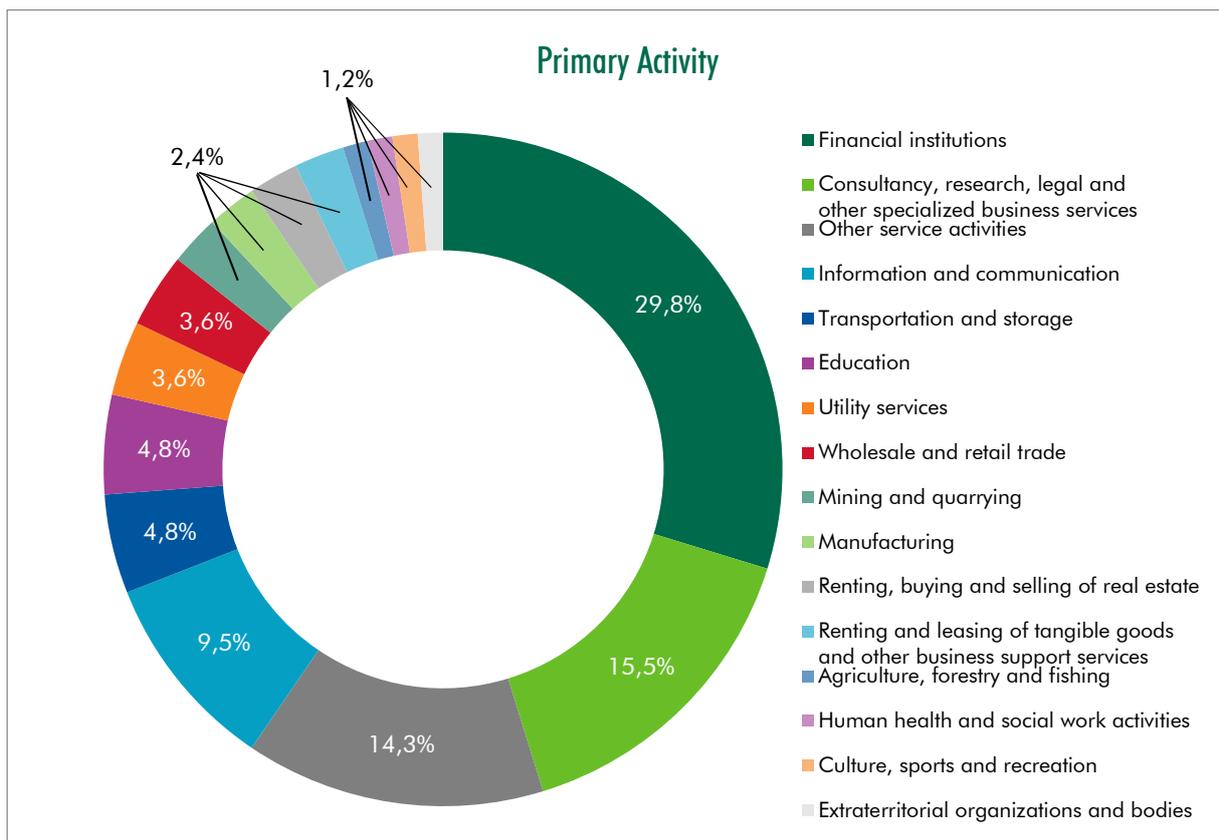
Figure 12. Distribution of business sectors (N=84)
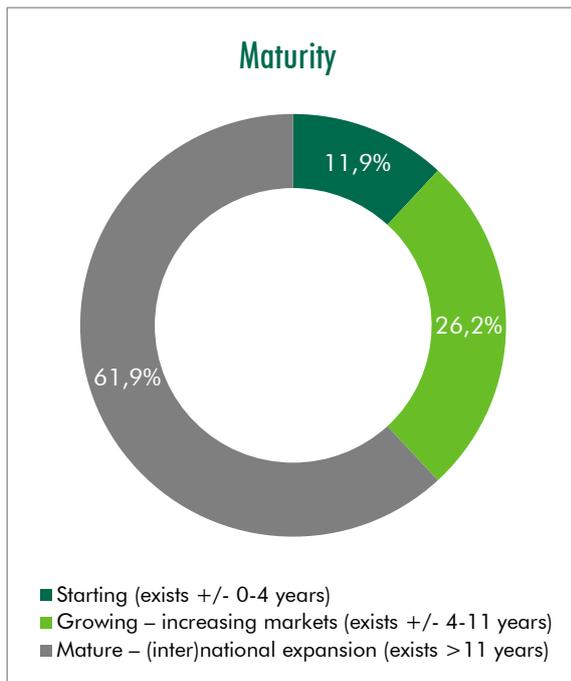
Figure 13. Distribution of organizational type (N=84)
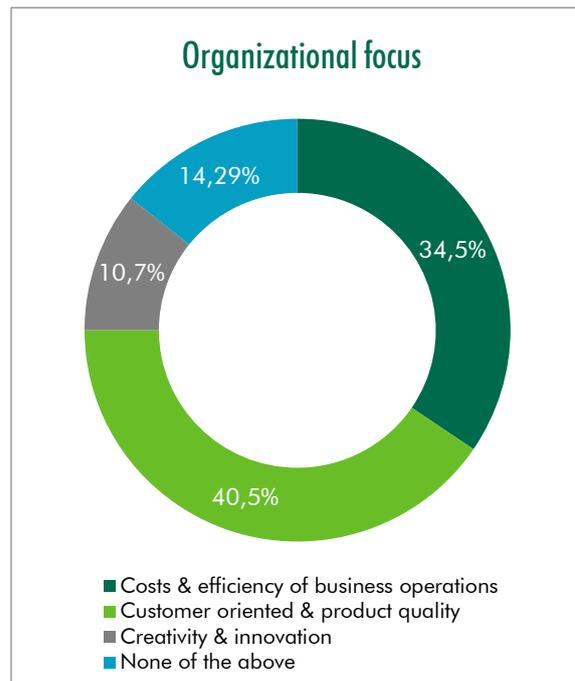
Figure 14. Distribution of organizational focus (N=84)

Maturity of the organization
Respondents were asked to describe the organization which they work for by choosing between three answers that include indications of an organization's maturity. Figure 13 shows that most of the respondents (61.9%) described their organization as 'mature', which stands for (inter)national expansion of markets and an existence of more than 11 years. Another 26.2% described their organization as 'growing' in the context of increasing markets and an existence between 4-11 years. Only a small part of the respondents described their organization as starting (11.9%) which categorizes entities of 0-4 years old. These results indicate that the sample includes mainly organizations of certain order that already have proved success and professionality in their business.

Organizational focus
The distribution of focus values that fit the most to (the part of) respondents' organizations that the concerning office building is displayed in figure 14. This biggest share of the sample is identified by organizations that are focused on their customers and product quality (40.5%). Organizations that focus on costs and efficiency of business operations are represented by 34.5% of the sample. Smaller parts of the sample are driven by creativity and innovation (10.7%) and the resting 14.29% answered that none of the three provided answers matched to their organizations. Overall these distribution shows that organizations are operating from an existing business model that is continuously improved instead of the main focus to search for completely new business.

Healthy strategies & policies
The awareness of workers' health as part of the organization's acting is identified in the questionnaire by asking whether organizations have policies or strategies in the field of employee health. The left side of figure 15 shows that 54.8% of the organizations in the sample implemented such policies or strategies and 28.6% did not. The resting 16.7% of respondents did know about the presence of it.
The that organizations that implemented such policies or strategies (54.8%), got a follow-up question about which kind of measures their organizations take to promote workers' health on which respondents were able to give multiple answers. The upper right of figure 15 presents that incentives for participation on things that promote health (e.g. gym subscription or bicycle compensation) occur often, followed by teaching or coaching on group or individual level. Also providing health assessments is done at some organizations.
From the organizations that did not implement strategy or policy regarding workers' health, it seems that most organizations do have the management support or the belief that it is the role of the organization to invest in workers' health (bottom right of figure 15). Other organizations also indicate that there is not enough consciousness about the subject or that there are no financial resources for the implementation of it.
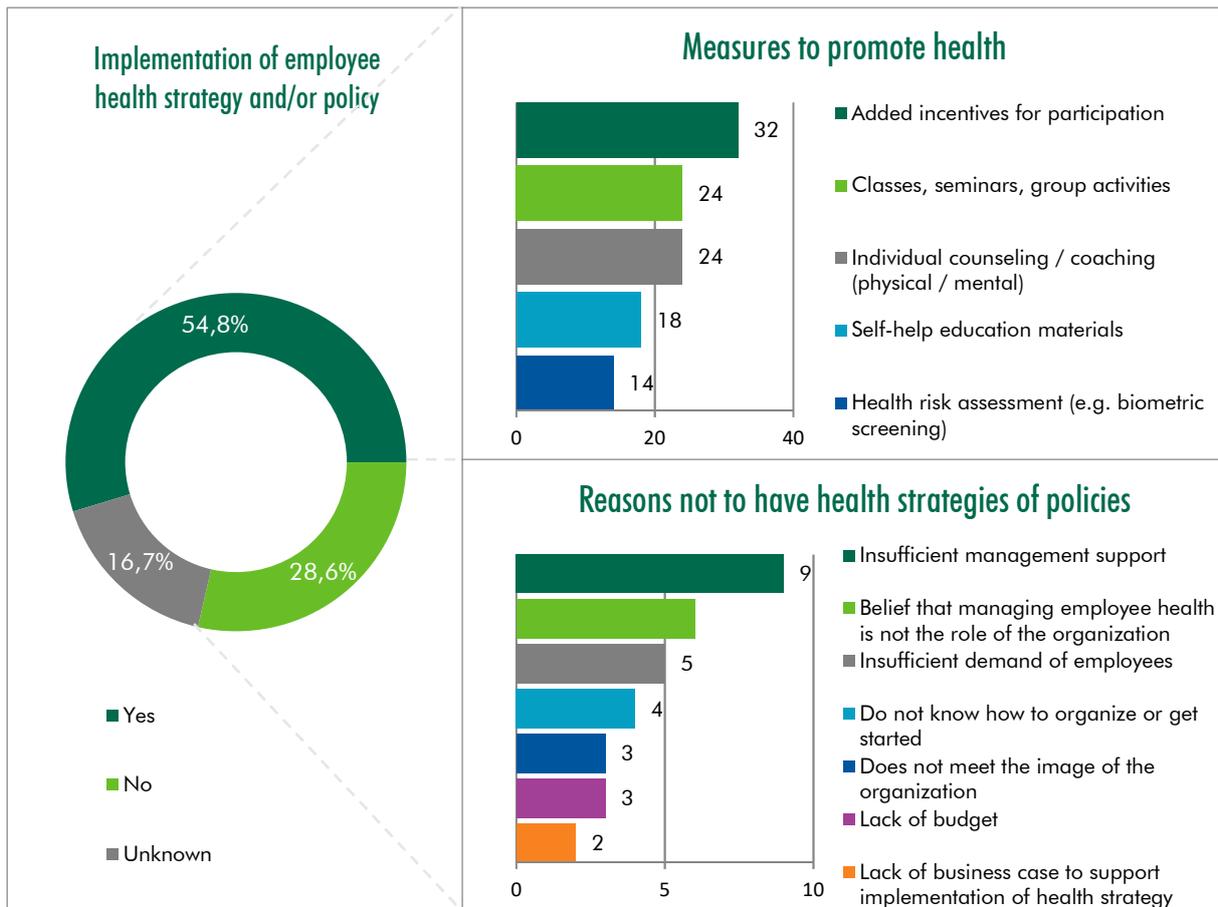
Figure 15. Distributions of presence of health strategies or policies within organizations (left), measures to promote health (upper right) and reasons not to have health strategies or policies (bottom right)

Relationships between Organizational characteristics

Chi-square tests of independence were also performed to examine the relations between all organizational characteristics. Therefore, also the precondition that no more than 20% of the expected count is less than five and the minimum expected count is at least one is needed (McHugh, 2013). For some of the variables, it was possible to merge or delete some answer options in order to fulfill this precondition. For those variables, a 'trial & error' approach is applied that repeatedly tried to find the combination of values with most favorable significance. In appendix I it is shown how this is done. The coding of variables of that table is explained in appendix H. So is the office building recoded in three different variables: one that is based on the city wherein the office building is located with the levels 'Amsterdam', 'Schiphol', 'Utrecht' and 'Rotterdam'; one that is based on the number of tenants in the office building with the levels '<100' and '>100' tenants; and one that is based on total lettable office space in the office building with the levels '<20,000', '20,000-50,000' and '>50,000' sqm. Furthermore, the number of FTE per organization in the office buildings is recoded into two groups, namely '< 20 FTE' and '>20 FTE'. Also the sector is recoded into fewer categories, being 'Financial services', 'Commercial services', 'Trade and Industry' and 'Other'. Further, the maturity of the organization is recoded into 'mature' and 'starting/growing'. At last, from the variables about the business center concept (type of lease) and the implementation of employee health strategies and/or policies, the answer possibility of 'unknown' is not taken into consideration into the Chi-Square tests, with the consequence that the N-value is lower at that Chi-Square tests. Besides the recoded variables, Chi-Square tests are also performed for the original ones.

Appendix J includes all statistics of the Chi-Square tests that meet the precondition of the amount and minimum of expected counts are displayed. The Chi-Square tests that did not meet the precondition were left out of consideration, so its statistics are not reported. Table 5 below has marked all significant dependencies with the letter [Y] (Yes). There are identified 35 significant differences between organizational characteristics with Chi-Square tests on 1%, 5% or 10% level. The coding of variables of the table is explained in appendix H.

Table 5. Statistics of the Chi-Square tests of independencies between organizational characteristics.

*	Building	BuildingCity	BuildingTenants	BuildingSize	Lease	Lease_Dir_Ind	FTE	FTE_S_M	FTE_Org	Focus	Sector	Sector_Less	Maturity	Mature_Y_N	HStrategy	HStrategy_Y_N	Promoting_M&S	Innovation	EmployeeSatisfaction	Productivity	Flexibility	CostEfficiency	Sustainability
Building		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
BuildingCity	-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
BuildingTenants	-	-		-	Y	Y	-	-	-	-	-	Y	-	-	-	-	-	Y	Y	Y	Y	-	-
BuildingSize	-	-	-		-	-	-	-	-	-	-	-	-	-	-	Y	-	-	-	Y	-	-	-
Lease	-	-	Y	-		-	-	Y	-	-	-	-	-	-	-	-	-	-	Y	-	-	-	-
Lease_Dir_Ind	-	-	Y	-	-		-	Y	Y	-	-	-	-	-	-	-	-	-	Y	-	-	-	-
FTE	-	-	-	-	-	-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
FTE_S_M	-	-	-	-	Y	Y	-		Y	-	-	-	Y	Y	Y	Y	-	-	Y	Y	-	-	-
FTE_Org	-	-	-	-	-	Y	-	Y		-	-	-	-	Y	-	Y	-	Y	Y	-	-	-	Y
Focus	-	-	-	-	-	-	-	-	-		-	-	-	-	-	-	-	-	-	-	-	-	-
Sector	-	-	-	-	-	-	-	-	-	-		-	-	-	-	-	-	-	-	-	-	-	-
Sector_Less	-	-	Y	-	-	-	-	-	-	-	-		-	-	-	-	Y	-	-	-	-	-	-
Maturity	-	-	-	-	-	-	-	Y	-	-	-	-		-	-	Y	-	-	-	-	-	Y	-
Mature_Y_N	-	-	-	-	-	-	-	Y	Y	-	-	-	-		Y	Y	-	-	-	-	-	-	-
HStrategy	-	-	-	-	-	-	-	Y	-	-	-	-	-	Y		-	-	-	-	-	-	-	-
HStrategy_Y_N	-	-	-	Y	-	-	-	Y	Y	-	-	-	Y	Y	-		-	-	-	-	-	-	Y
Promoting_M&S	-	-	-	-	-	-	-	-	-	-	-	Y	-	-	-	-							
Innovation	-	-	Y	-	-	-	-	-	Y	-	-	-	-	-	-	-							
EmployeeSatisfaction	-	-	Y	-	Y	Y	-	Y	Y	-	-	-	-	-	-	-							
Productivity	-	-	Y	Y	-	-	-	Y	-	-	-	-	-	-	-	-							
Flexibility	-	-	Y	-	-	-	-	-	-	-	-	-	-	-	-	-							
CostEfficiency	-	-	-	-	-	-	-	-	-	-	-	-	Y	-	-	-							
Sustainability	-	-	-	-	-	-	-	-	Y	-	-	-	-	-	-	Y							

All tests that did not meet the precondition or of which there was no significant chi-square found, there exists independence between the concerning variables what means that the distributions of both variables did not differ by the other. These tests are marked with an [-] in table 5. When looking into the cross tables of all significant dependencies, it can be found what dependency between the variables exists based on the included characteristics that were generated from the question answers. Those relations are described as follows.

As shown in table 5, multiple dependencies exist between the number of tenants in the office building and other variables. A distinction is made between office buildings wherein more than 100 tenants lease and office buildings wherein less than 100 tenants lease. In office buildings wherein more than 100 tenants lease, it is more likely that the total lettable office space in the office building is larger; it is more likely that tenants lease directly from the landlord (and thus leasing in the regular business center instead of the serviced offices); it is more likely to operate in financial services and commercial services and less in other activities; and are concerning the leased space generally less focused on innovation, employee satisfaction and flexibility but more on productivity.

Table 5 also shows multiple dependencies between the number of FTE per organization in the office buildings of which distinction is made between less than 20 FTE and more than 20 FTE. Organizations that lease office space from the CBRE Dutch Office Fund for more than 20 FTE are more likely to lease directly from the landlord (and thus leasing in the regular business center instead of the serviced offices); are more likely to have higher percentages of their workers in that office building related to the whole organization; are relatively more mature

organizations; have more often incorporated a health policy or strategy; and are generally more focused on employee satisfaction and slightly less on productivity for the concerning leased space.

The proportion of FTE related to the total organization is also dependent on some variables except the number of FTE in the office building. When it is a small part (<25%) of the organization that lease office space or a large part (75-100%) it does occur more often that the organization lease office space from the serviced office operator than all in between (25-75%) which are generally more leasing directly from the landlord. Also, when a smaller part of the total organization is leasing, it is more likely that the organization is relatively more mature as well as it more often has implemented a health policy or strategy. Furthermore, smaller proportions of FTE related to the total organization are concerning the leased space slightly less focused on innovation, employee satisfaction and sustainability.

Other dependencies that are found are that organizations which lease in larger total building sizes are more likely to have implemented a health policy or strategy as well as they focus more on productivity; that organizations which lease via the serviced office operator are less likely to focus on employee satisfaction for that serviced office space; that more mature organizations do more often have implemented a health policy or strategy as well as those organizations are slightly more focused on cost efficiency for the concerning leased space; that organizations of which their primary activities are financial services or commercial services are generally more focusing on promoting marketing & sales; organizations that implemented a health policy or strategy in their organization are more focused on cost efficiency of the concerning leased space.

Revealed choice of building characteristics

During the questionnaire, respondent were also asked to rate their current office on the same attribute levels as included in the Stated Choice Experiment in order to compare (1) how respondents rate their current rented office to the actual situation, (2) to reveal how respondents rate their current rented office in order to compare their preference for healthy office workplace characteristics of the SCE with their current experience so it may uncover if a low current state is related to a higher demand for a better state or vice versa and (3) to get used to the attribute levels that will follow in the remaining questions. The first function is possible by comparing the rates of respondents with knowledge of the technical manager of the CBRE Dutch Office Fund that selected the actual attribute levels per office building. That selection is given in appendix K. With those values, statistics are derived through calculating the rating differences per attribute level per building, see figure 16 till figure 21. In those statistics, these differences are divided into higher or lower rates than the actual situation. The attribute 'Provisions' is not taken into account since that does not concern the perceiving of respondents because it is a fact whether those are included in buildings or not. The rating of respondents is probably not secure enough and may include provisions outside the office building.

As shown, most of the respondents rate indoor air quality and thermal comfort the same or lower as the actual situation. For exposure to light and noise & acoustics, the distribution of rate differences is slightly equal. For office type, most respondents rate their offices 'lower'. Nonetheless, it is impossible to conclude something about that because the attribute levels are less ordinal and it concerns the leased space which applicated concept is not of influence of the landlord (only the possibility to apply the concept). Views are generally rated equal or better by respondents.
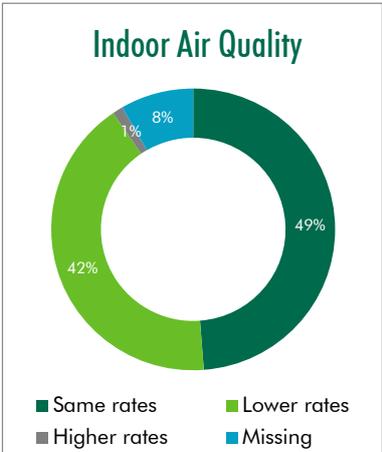

Figure 16. Differences between revealed choice and actual situation of Indoor Air Quality
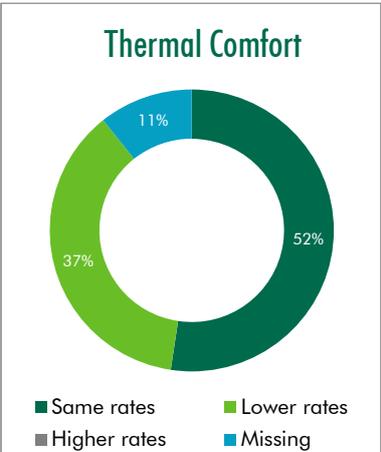
Figure 17. Differences between revealed choice and actual situation of Thermal Comfort
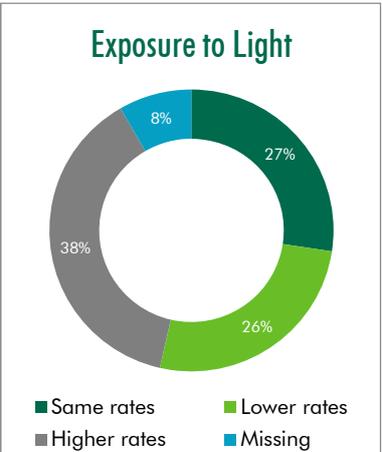
Figure 18. Differences between revealed choice and actual situation of Exposure to Light
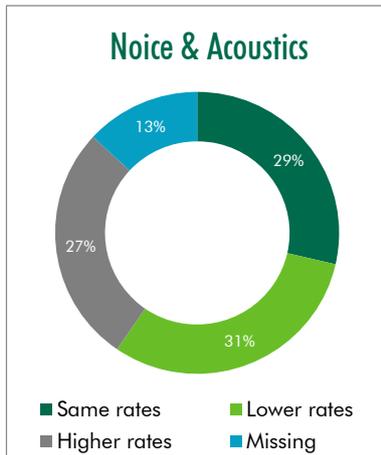
Figure 19. Differences between revealed choice and actual situation of Noise & Acoustics
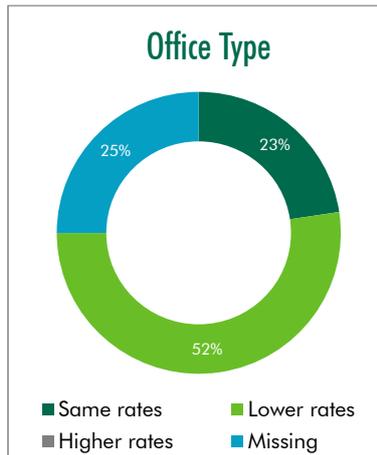
Figure 20. Differences between revealed choice and actual situation of Office Type
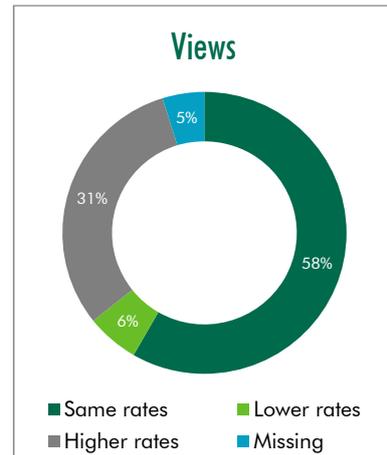
Figure 21. Differences between revealed choice and actual situation of Views

Furthermore, no dependencies are found between revealed choice building characteristics and demographic or organizational characteristics, so these are not further discussed. In addition, the data of the revealed choice question was not adequate enough to fulfill the second goal because too many respondents gave missing answers. Therefore, it is not completely ruled out if the third goal is achieved completely. Nonetheless, the data from the SCE that is derived from the questionnaire is adequate for further analysis which is discussed in the next section.

5.4 RESULTS

In the following section, the analysis of the Stated Choice Experiment is described. First, the overall preferences of tenants for healthy office workplace characteristics are estimated with the aid of the Multinomial Logit Model followed by the overall Willingness to Pay (WTP) for attributes and attribute levels. Next, different segments in the sample based on similar stated preferences considering demographic and organizational characteristics are estimated through Latent Class models.

Respondents were asked to always choose the imaginary office workplace they preferred the most, being one of the two presented alternatives with healthy office attribute levels. When they did not prefer both options they were asked to choose 'No preference', being the constant alternative. To indicate how the sample has filled in the stated choice part of the survey, some descriptive statistics are given first to gain insight into the collected data. Since there are 84 respondents that completed the questionnaire and generated useable data, there are 756 (=84 * 9) observations made. This means that there are in total 2,268 (=756 * 3) alternatives observed. Of all observations, respondents chose 150 times (19.8%) for the 'No preference' option, suggesting they did not prefer both choices. In all other 606 observations one alternative is selected.

NLogit Command

After data preparation of the dependent variables as explained in paragraph 5.2, the parameters of the MNL and LC models are estimated for the dataset in Nlogit with the command as given in appendix L. In this command, the 'Choices' represent the possible alternatives; 'pds' the amount of choice tasks each respondent observed; 'Lhs' the dependent variable; 'Rhs' the independent variables (of which names based on appendix [x]); 'parameters' to request computation of conditional class probabilities so each respondent can be assigned to a class; and 'pts' as the number of classes (Greene, 2012). The running of the command to the prepared dataset in Nlogit results in output that can be found in appendix M and O.

Multinomial Logit Model

Prior to the estimation of the Multinomial Logit Model, the goodness of fit is determined to check if the model performs properly (table 6). This is done by calculating the McFadden's Rho-Square (ρ^2) as elaborated in section 4.2. The log-likelihood of the estimated model (LL(β)) is -707,842 and the log-likelihood of the null model (LL(0)) is -830,551. This results in a ρ^2 of 0,148. The adjustment of the ρ^2 for the number of alternatives and the number of parameters in the model results in the ρ^2_{adj} of 0.127. The ρ^2_{adj} is somewhat lower than 0.200 which means that the model does not fully represent the observed choices well what means that there are overall differences in the preferences of the respondents, also called heterogeneity. It is also possible that respondents themselves have chosen inconsistent.

Table 6. Parameters for model fit of MNL model (N=84).

Goodness of fit	Multinomial Logit Model
Log-likelihood estimated model (LL(β))	-707.842
Log-likelihood null model (LL(0))	-830.551
McFadden's Rho-Square (ρ2)	0.148
Adjusted McFadden's Rho-Square (ρ²adj)	0.127
Number of parameters	17

Before applying the utilities to the choice probabilities of healthy office workplace characteristics, the parameter coefficients (β-values) that are estimated by the model will be discussed in general. These β-values represent the part-worth utility of the attribute levels. As discussed in section 5.2 and displayed in appendix G, level 0 of the first attribute is equal to $\beta 1$, the second attribute level to $\beta 2$, the third attribute level to $-(\beta 1 + \beta 2)$, and so on. When respondents did not prefer both options they were asked to choose 'No preference' of which is estimated by the constant $\beta 0$, being the constant alternative. In order to identify the parameters of the model, $\beta 0$ is normalized to zero (Greene, 2012). All β-values are displayed in table 7 in which the model labels from Nlogit are replaced by their corresponding attribute level labels. The entire output from Nlogit including model labels and all statistical details is available in appendix M.

Table 7. Utility coefficients of the MNL model. (Choices=756, N=84).

Attribute	Attribute level	Coefficient (β)	Sig.	Corrected β	z
Constant	Preference	0.663	***	0.663	7.060
Indoor Air Quality	Ventilation indoor-outdoor air	-0.049		0	-0.610
	Ventilation with air treatment	-0.167	**	-0.167	-2.060
	Ventilation with air treatment and air filtering	0.216		0.167	
Thermal comfort	Radiators + Airco-units (much comfort fluctuation)	-0.369	***	-0.369	-4.420
	Controlled system with comfort fluctuation	-0.040		0	-0.500
	Balanced system with minor comfort fluctuation + Adjustable per space	0.409		0.369	
Exposure to light	Standard window size + Standard light fittings	-0.078		0	-0.960
	Standard window size with sun blinds + Light fittings with daylight correction	-0.039		0	-0.490
	Large window size with adjustable sun blinds + Adjustable light fittings	0.118		0	
Noise & Acoustics	No acoustic measurements	-0.358	***	-0.358	-4.290
	Acoustic insulation external sound sources	0.058		0	0.710
	Acoustic insulation external & absorption internal sound sources	0.300		0.358	
Office type	Open workfloor	-0.227	***	-0.227	-2.670
	Cell office	0.166	**	0.166	2.040
	Flexible office	0.062		0.062	
View	Only urban environment	-0.185	**	-0.185	-2.270
	Combination of urban and green elements	0.040		0	0.510
	Fully green environment	0.145		0.185	
Provisions	Reception + Standard company restaurant	-0.338	***	-0.338	-4.190
	Reception + Healthy company restaurant	0.050		0	0.620
	Reception + Healthy company restaurant + Fitness + (Retail)services	0.288		0.338	
Rental price	Current rent	0.516	***	0.516	6.320
	Current rent + 5%	0.178	**	0.178	2.150
	Current rent + 10%	-0.694		-0.694	

***, **, * → Significance at 1%, 5%, 10% level

As shown, table 7 contains two columns with β-values. The 'Coefficient (β)'-column shows the parameters as provided by the Nlogit model output. The 'Sig.'-column shows the significance per attribute level which is also provided by the Nlogit model output. The asterisks symbols ***, ** and * mean respectively significance at 1%, 5% and 10% level. If an attribute level is insignificant to one of these three levels, it does not contribute to the preferences for office workplace characteristics. That means that the coefficient must be corrected to 0.000 which is done in the 'Corrected β'-column. Such correction can influence the 'Corrected β'-coefficient of the

third attribute level as well since it equals −(β1 + β2). That entails that one or both of the first attribute level (β1) and the second attribute level (β2) must be significant to compute a non-zero value for the third attribute level. If both the first and the second attribute levels are insignificant and thus are corrected to 0.000, the third level will also be 0.000.

The first row of table 7 shows that the constant β0 is positive and significant, which indicates that the respondents more often have a preference for one of the profiles with office workplace characteristics instead of the 'No preference' alternative. All other significant β-values indicate that those attribute levels contribute to the preferences for office workplace characteristics, wherein a positive β-value indicates a preference and a negative β-value indicates a dislike for an attribute level. A larger β-value indicates a stronger preference or dislike for the attribute level.

Further analysis of the MNL is based on 'Corrected β'-column of table 7. All of the attributes have at least one significant level, except the attribute 'Exposure to Light'. That means that it did not play a role in decision making for office workplace characteristics. Except for 'Office type' and 'Indoor Air Quality', the part-worth utilities of all other attribute levels follow ordinal order within their attribute to respectively low, medium and high healthy office concepts. That indicates that, apart from the 'Office type' and 'Indoor Air Quality', respondents have more preferences for healthier attribute levels. The part-worth utilities of the attribute levels for the assumption of the 'Rental price' strongly differ from each other, of which lower preference is given to assumptions of higher rental values.

Before discussing the part-worth utilities more in-depth per attribute, it is interesting to examine how the attributes can be compared with each other in terms of relevance. In order to determine this, each attribute importance is computed by the difference between the lowest and the highest 'Corrected β'-coefficient which indicates the absolute range between the highest and lowest utility of the attribute. The relative importance of each attribute (in %) on office workplace preferences is computed by the ratio between each particular attribute importance and the total importance of all attributes (Randle, Kemperman, & Dolnicar, 2019). Those outcomes are put together in figure 22.
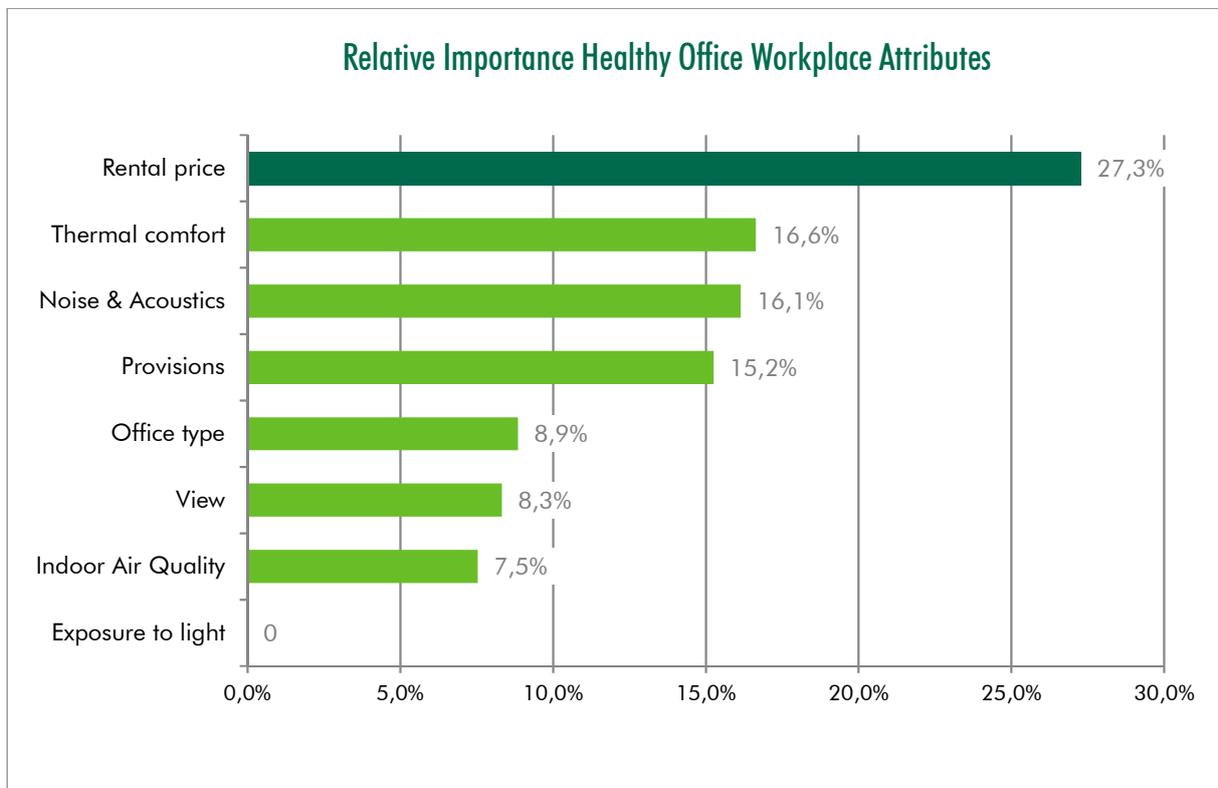

Figure 22. Relative Importance of healthy office workplace attributes (Choices=756, N=84).

As one can see, the relative importance of 'Exposure to light' is zero since none of its model estimates has a significant β-value and thus all 'Corrected β'-coefficients are zero. All other attributes have at least one significant attribute level and thus have importance. Among those attributes, the 'Rental price' is with 27.3% relatively the most important in respondents' considerations. Subsequently, 'Thermal comfort', 'Noise &

Acoustics' and 'Provisions' have a relatively high impact on respondents' choices within a 15.2-16.6% range. Hereafter, the importance drops again to a 7.5-8.9% range for the attributes 'Office type', 'View' and 'Indoor Air Quality'.

When getting into the part-worth utilities of the attributes, detailed preferences for workplace characteristics become clear. In the questionnaire, the 'Indoor Air Quality' was addressed as way the air in the office spaces is ventilated. A distinction is made in implementation of air treatment (moisture and CO_2 concentration) and air filtering (extracting fine dust, odors, bacteria). Among the attribute levels, it seems that respondents do not assign utility to ventilation of indoor-outdoor air (0.000), suggesting such system does not contribute to the preference or the dislike of an office workplace. One explanation therefor could be that physical contact with outdoor air is neutralizing perceived air quality due to letting in associations of outside air with 'fresh' air. A ventilation system with only air treatment is disliked by respondents since it has a negative utility (-0.167). Respondents only prefer a ventilation system with air treatment enriched with air filtering (0.167), suggesting that only an optimized system is favored in the workplace.

The 'Thermal comfort' of a workplace was presented as the way the temperature in the office spaces is controlled with a distinction of system type, comfort fluctuation and adjustability. Respondents strongly disliked an imaginary workplace with radiators combined with airco-units that lead to much comfort fluctuation (-0.369). A controlled system with comfort fluctuation was neither disliked, nor preferred (0.000). A balanced system with minor comfort fluctuation and adjustability per space was highly preferred (0.369). This suggests that mitigating comfort fluctuation and enhancing (personal) control over temperature is increasing preference of respondents.

The attribute 'Exposure to Light' was defined in the questionnaire as the amount and quality of light at a workstation. As mentioned, the model estimated no significant coefficients of attribute levels which mean that no attribute level has been found to be preferred over another. Thus, the combination of window size, availability of sun blinds, and configuration of light fittings have not been found differ among respondents' preferences. It is possible that there was preference of particular components in this combination, but that cannot be subtracted from the model estimates.

The reduction of noise through acoustic measures was meant with the attribute 'Noise & Acoustics'. This reduction can be achieved by blocking noise from outside the office (traffic, building installations, etc.) as well as absorbing noise within the office space (footsteps, conversations, etc.). The application only acoustic insulation of external sound sources is both not disliked or not preferred (0.000), which may not be very surprising since this is familiar in an office environment. But when there are no acoustic measurements applied in a workplace, respondents dislike that much (-0.358). In contrast, a considerable preference is estimated for both acoustic insulation of external sound sources and absorption of internal sound sources (0.358).

Non-ordinal order was found for 'Office Type', entailing by the layout and floor plan of the office spaces distinguished by an open workfloor, a cell office and a flexible office. An open workfloor has no walls; a cell office consists of enclosed spaces for maximum 3 persons; a flexible office consists of different types of workplaces without a fixed workstation per employee. A positive part-worth utility was estimated for the cell office (0.166), followed by a slight positive estimate for the flexible office (0.062). A negative part-worth utility was found for office workplaces with an open workfloor (-0.227). In general, this indicates that respondents prefer the possibility to create a variety of (enclosed) workspaces in the leased space. Whether they prefer a fixed or unfixed workstation cannot be traced since the utilities of the open office (negative) and cell office (positive) are in contrast while they both incorporate fixed work stations. Nonetheless, this is part of the leased space and does not cover the focus of this research.

The attribute 'View' considers the degree of green elements towards urban elements in the view from the windows from the workplace. In that consideration, green elements are assumed to be applied in public spaces (trees, grass, etc.) as well as on the facades and roofs of the office building itself. A combination of urban and green elements is estimated to have no impact on respondents' preference and dislike (0.000). Nonetheless, a total absence of green elements was disliked (-0.185) against a preference for a fully green environment (0.185). These utilities signify that the respondents' preferences for workplaces roughly increases with higher degrees of green elements in the view from the office.

The presence of facilities in the office building was mentioned with 'Provisions' in the questionnaire. Respondents were explained that in addition to a reception and a company restaurant, these can also be facilities that encourage healthy nutrition and physical activity or those that stimulate social integration or reduce stress. The utilities of the attribute levels show that a reception with a standard company restaurant was disliked by respondents (-0.338). Substituting the standard company restaurant with a healthy variant, eliminates the dislike of respondents but does not create a preference of respondents (0.000). To reach a substantial preference, more facilities like fitness or retail must be added (0.338). These utilities demonstrate that a healthy nutrition provision is essential to prevent respondents' dislike. Adding more provisions that encourage workers' health can rise respondents' preference work office workplaces.

The 'Rental price', being the assumption of the rent of a square meter of office space, does not include workplace characteristics that promote health. Even though, the part-worth utilities of the attribute levels are important to describe. As mentioned, their part-worth utilities strongly differ from each other and lower at higher rental value assumptions. The assumption of the current rent is therefore preferred the most to remain the same (0.516), but the current rent plus 5% is acceptable and not disliked (0.178). A vast dislike appears when the assumption of the rental price is set on current rent plus 10% (-0.694). This indicates that respondents are fine with higher office rents for when more (healthy) office workplace characteristics they prefer are applied in the office, but the majority disengages toward the 10% increase.

Willingness to pay Multinomial model

After the recoding of the attribute levels of the rental price as shown in table 4, the MNL model has estimated again with the same command (only Arp and Brp are substituted by RPWTP) of which outcomes are shown in appendix N. When comparing these to table 7, it seems that all coefficients of workplace attribute levels differ a tiny bit. Nonetheless, the differences are acceptable in order to consider both models' estimates as similar and thus make both models useable for analysis. Given that the model that follows the WTP coding estimates a single WTP-factor, the coefficients from that model output will be used for further WTP-calculations. An extra confirmation of the comparability of both model estimates is the WTP-coefficient, which is in the new MNL model -0.120 per % and in the old model -1.21(=−0.694 − 0.516) for the utility difference of 0% to 10%. Both numbers indicate a similar factor for a 10% range.

Figure 23 show these WTP estimates for three measures per attribute: one for the enhancement from a low to a medium health quality office workplace, one for the enhancement from a medium to a high health quality office workplace and one for the enhancement from a low to a high health quality office workplace. The figure shows, with two exceptions, merely positive WTP for rent increases due to the investigated measures that increase health in the office workplace. One negative WTP is assigned to the utility difference between the medium to a high health quality office type, being the cell office type to the flexible office. The other negative WTP is assigned to the utility difference between the medium to a high health quality office workplace. Note that when an office workplace will be reduced from one attribute level to a lower attribute level (e.g. high to medium), the inverse of every positive WTP percentage leads to a negative WTP. In other words that entails that tenants should be paid to switch to an office workplace that consists of lower 'attribute levels'. In that view, the exception belongs to switching from a flexible office type to a cell office type or from ventilation with air treatment to ventilation of indoor-outdoor air.
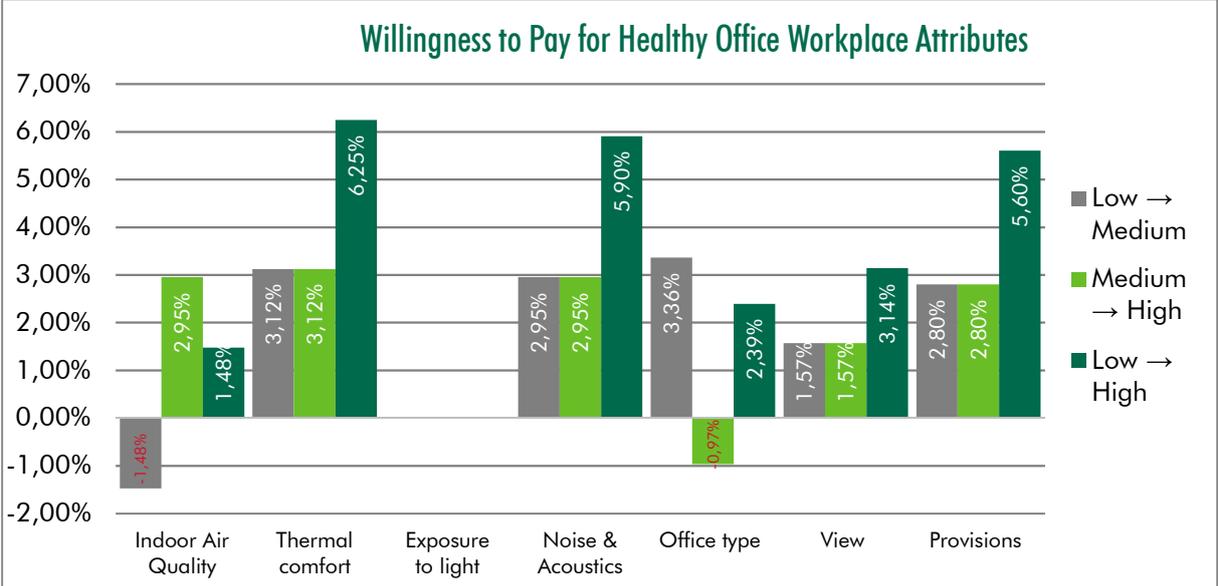

Figure 23. Willingness to Pay for healthy office workplace attributes as factor of the current rental price

As presented, both WTPs of 'Exposure to light' remain zero because the 'Corrected β'-coefficients are zero. The WTP of almost all other attributes is higher for the enhancement from a low health quality to a healthy office workplace than the enhancement from a medium to a high health quality office workplace. Related to a low health quality office workplace, the highest WTP is assigned to 'Thermal comfort' (6.25%) when switching to a healthy office workplace. Subsequently, relatively high WTPs are assigned to 'Noise & Acoustics' (5.90%) and 'Provisions' (5.60%). Hereafter, the WTP drops to 3.14% for 'View', 2.39% for 'Office Type' and 1.48% 'Indoor Air Quality'.

The percentage from a low to a medium health quality office workplace and a medium to a high health quality office workplace are almost similar. Only the WTP for the attribute 'Indoor Air Quality' is higher when improving from medium to a high health quality office workplace, even more than improving from low to a high health quality office workplace. A similar association counts for the WTP for 'Office Type' of which the low to medium health quality office workplace is higher than the other improvements. For the other attributes, all WTPs are markedly lower when making such improvements. From this perspective, the highest WTP is again assigned to 'Thermal comfort' (3.12%). Thereafter, 'Indoor Air Quality' (2.95%), 'Noise & Acoustics' (2.95%) and 'Provisions' (2.80%) follow. Furthermore, 'View' is rather lower with a WTP of 1.57%. Besides the WTP-values per attribute, it is also interested to know what the WTP is for the office qualities as a whole. Therefore, two types of calculations are made that determine a WTP-range for improving an office quality as a whole. For each calculation type this is done for the same utility differences as mentioned before, namely from a low to a medium health quality and a medium to a high health quality. One calculation is done for an optimistic situation, that estimates a maximum by the sum of the parts of all WTP-values of single aspects (table 8). The other calculation is based on a conservative situation and estimated a minimum by the weighted average. Therefore, the values of the relative importance of each aspect (figure 22) are multiplied with the WTP-values of single aspects before those were summed (table 9).

Table 8. Maximal overall willingness to pay for healthy offices

Optimistic maximum: Sum of the parts		
	Total utility	WTP %
Low → Medium Health Quality	1.479	12.33%
Medium → High Health Quality	1.491	12.43%
Low → High Health Quality	2.969	24.76%

Table 9. Minimal overall willingness to pay for healthy offices

Conservative minimum: Weighted average		
	Total utility	WTP %
Low → Medium Health Quality	0.208	6.37%
Medium → High Health Quality	0.202	6.17%
Low → High Health Quality	0.411	12.54%

Based on table 8 and table 9, the price range from a low to a medium health quality office is 6.37 – 12.33%, medium to a high health quality office is 6.17 – 12.43% and a low to a high health quality office is 12.54 – 24.76%.

Latent Class models

The Latent Class models are performed in order to identify groups of respondents so segments can be derived that have different preferences for attribute preferences. LC-models can identify panel data which means that it incorporates unobservable respondent specific parameters to find correlations between observations that are common to a respondent (Hensher, Rose, & Greene, Applied choice analysis: a primer, 2005). Those individual-specific parameters allow identifying similarities within groups. Through applying chi-square tests and independent samples T-tests, significant differences of demographic and organizational characteristics between the groups are estimated.

For Latent Class models also applies that the ρ^2_{adj} must be higher than 0.200 for a good fit. Moreover, the Akaike Information Criterion is calculated for each LC model to determine the optimal number of classes. The model with the lowest AIC value is assumed to fit the best. Nonetheless, there is only one LC model that can identify classes, being the model for two classes. When investigating for more classes, NLogit cannot distinguish classes. This can be due to the relatively small sample size in combination with the number of parameters in the model. The calculations of the LC model fit with two classes (AIC = 1278.3) are displayed in table 10. The LC model shows that there is a number of 35 parameters used, leading to an Adjusted McFadden's Rho-Square (ρ^2_{adj}) of 0.255. Since this number is higher than 0.200, the model represents the observed choices well what means that the preferences of the respondents within classes do not differ much what indicates homogeneity.

Table 10. Parameters for model fit of LC model (N=84)

Goodness of fit	Latent Class model(s)
Log-likelihood estimated model (LL(b))	-604.140
Log-likelihood null model (LL(0))	-830.551
McFadden's Rho-Square (ρ2)	0.273
Adjusted McFadden's Rho-Square (ρ²adj)	0.255
Number of parameters	35

The entire Nlogit output of the 2-classes LC model including model labels and all statistical details is displayed in appendix O. For every observation a respondent made, the probability of whether the respondent belongs to class 1 or class 2 is estimated, based on their preferences for the total treatment combinations that the respondents had to choose from. The respondent belongs to the class with the highest probability. That resulted in the allocation of 47 respondents to class 1 and 37 respondents to class 2. The first class contains 47 respondents (=56% of sample), the second class 37 respondents (=44% of sample). The 'Corrected β'-coefficients of the two classes (LC1 and LC2) and the MNL model are incorporated in table 11. The values in the model can be interpreted in the same manner as the values of the MNL model. So, significant β-values of attribute levels indicate the contribution to the preferences for office workplace characteristics of that class, wherein positive β-values indicate preference and negative β-values indicate dislike for attribute levels. Larger β-values indicate stronger preference or dislike for the attribute levels.

Table 11. Utility coefficients of the MNL model and 2-class LC model. (Choices=756, N=84).

		MNL	LC1	LC2
Attribute	Attribute level	Corrected (β)	Corrected (β)	Corrected (β)
Constant	Preference	0.663	2.138	-1.671
Indoor Air Quality	Ventilation indoor-outdoor air	0	0	0
	Ventilation with air treatment	-0.167	0	0
	Ventilation with air treatment and air filtering	0.167	0	0
Thermal comfort	Radiators + Airco-units (much comfort fluctuation)	-0.369	-0.381	0
	Controlled system with comfort fluctuation	0	0	0
	Balanced system with minor comfort fluctuation + Adjustable per space	0.369	0.381	0
Exposure to light	Standard window size + Standard light fittings	0	0	-0.470
	Standard window size with sun blinds + Light fittings with daylight correction	0	0	0
	Large window size with adjustable sun blinds + Adjustable light fittings	0	0	0.470
Noise & Acoustics	No acoustic measurements	-0.358	-0.474	0
	Acoustic insulation external sound sources	0	0	0.374
	Acoustic insulation external & absorption internal sound sources	0.358	0.474	-0.374
Office type	Open workfloor	-0.227	-0.203	-0.556
	Cell office	0.166	0	0
	Flexible office	0.062	0.203	0.556
View	Only urban environment	-0.185	0	-0.638
	Combination of urban and green elements	0	0	0
	Fully green environment	0.185	0	0.638
Provisions	Reception + Standard company restaurant	-0.338	-0.369	0
	Reception + Healthy company restaurant	0	0	0
	Reception + Healthy company restaurant + Fitness + (Retail)services	0.338	0.369	0
Rental price	Current rent	0.516	0.386	1.511
	Current rent + 5%	0.178	0.239	0
	Current rent + 10%	-0.694	-0.625	-1.511

The constant (β0) coefficients of the LC model differ per class. The β0 of class 1 is very positive and significant, meaning that those respondents often have a preference for one of the profiles with office workplace characteristics instead of the 'No preference' alternative. The β0 of class 2 is fairly negative and significant, meaning that those respondents often chose for the 'No preference' alternative.

As one can see, the values of the part-worth utilities for each attribute level differ per class as well. Like the MNL model, some attributes or attribute levels have a value of zero due to insignificance. But, the insignificance of particular attributes or attribute levels is equal between both classes. The only similarity was found at the attribute 'Indoor Air Quality', of which all three attribute levels of both classes are insignificant. This means that the 'Indoor Air Quality' did not play a role in decision making for office workplace characteristics for both classes. In figure 24, all part-worth utilities for all attributes levels of the MNL and LC models (Class 1 = LC1, Class 2 = LC2) are provided in a visual chart so discrepancies can be remarked easily.

The figure demonstrates discrepancies in the presence of utilities, the order of utilities within an attribute, and the sizes of values of the utilities. The further analysis of the LC model describes the effect of these factors per attribute. As mentioned, these cannot be described for the attribute 'Indoor Air Quality', since both classes have no significant attribute level utilities.

For 'Thermal comfort', LC1 show comparable order of utilities as for the MNL model of which value sizes are somewhat larger. It shows a slight stronger dislike for radiators combined with airco-units and a bit higher preference for a balanced system. LC2 has no significant utility values what means that the decisions that were made by the respondents in that class were not influenced by the attribute levels that contained system types that have an effect on comfort fluctuation and adjustability of temperature in office spaces. This suggests that LC1 is driving the influence of importance of the 'Thermal comfort' attribute for the whole sample.

'Exposure to Light' was insignificant and thus indicate absence of utilities in the MNL model, meaning that there was no preference for a specific attribute level over another. For LC1, this non-preference is found as well. Nonetheless, the order and value size of the LC2-utilities show a clear dislike for standard window sizes and standard light fittings against a strong preference for large window sizes with adjustable sun blinds and adjustable light fittings. This indicates that the sample as a whole has no specific preference, but a particular subgroup has a clear preference for healthy characteristics concerning light in the workplace.

The order of utilities of LC1 of the attribute 'Noise & Acoustics' are similar to the MNL model, but show larger value sizes thus stronger preference for both acoustic insulation of external sound sources and absorption of internal sound sources and more dislike for no acoustic measurements. In contrast, the utilities of LC2 have a different (non-ordinal) order. The subgroup shows a preference for only insulation of external sound sources and a dislike for both acoustic measurements.

The non-ordinal order that was found for the MNL model of 'Office Type' was not found for the LC models which both show an ordinal order. Both classes express dislike for the open workfloor, neither dislike nor preference for the cell office and a preference for the flexible office. LC1 differs from LC2 in smaller utility value sizes. That indicates that respondents of LC2 are more focused on a 'healthy' layout and floor plan of office spaces in their choice for their organizations' office workplace.

For the attribute 'View', there is also a discrepancy between the two classes. LC1 shows no significant utility values, meaning that they consider the degree of green elements as not important in the choice for their organizations' office workplace. LC2 follows the same order as the MNL model but shows substantial larger utility value sizes. So, they show a great dislike for a total absence of green elements, a high preference for a fully green environment and no precedence to the combination of both.

The preferences and dislikes for the combination of 'Provisions' are also different between the two classes. LC1 follows the order of the MNL model with a bit larger utility value sizes, being a preference for a variety of provisions in office buildings and a dislike for buildings that only have the standard provisions. LC2 does not care about the extent of facilities, which is indicated by all insignificant utility values.

For the 'Rental price' all attribute level utilities follow ordinal order for both the MNL model and the LC model. LC1 has the same presence of utilities as the MNL model, but the utility level sizes differ. The assumption of the current rent has a lower preference, the current rent plus 5% has a bigger preference and the current rent plus 10% is disliked less than the MNL model. This indicates that class 1 is generally more willing to pay for healthy office workplace aspects. The LC2 has no significant utility value for the current rent plus 5%, but a substantial higher preference for remaining the current rent as well as a substantial bigger dislike for the assumption of the rental price of the current rent plus 10%. This indicates that LC2 has less WTP for healthy office workplace aspects.

Overall, one market segment has more preference for healthier levels of thermal comfort, noise & acoustics, and provisions and is more willing to pay for the office workplace characteristics they prefer. The other market has more preference for healthier levels of light exposure, office type and view, but is less willing to pay for their preferred office workplace characteristics.
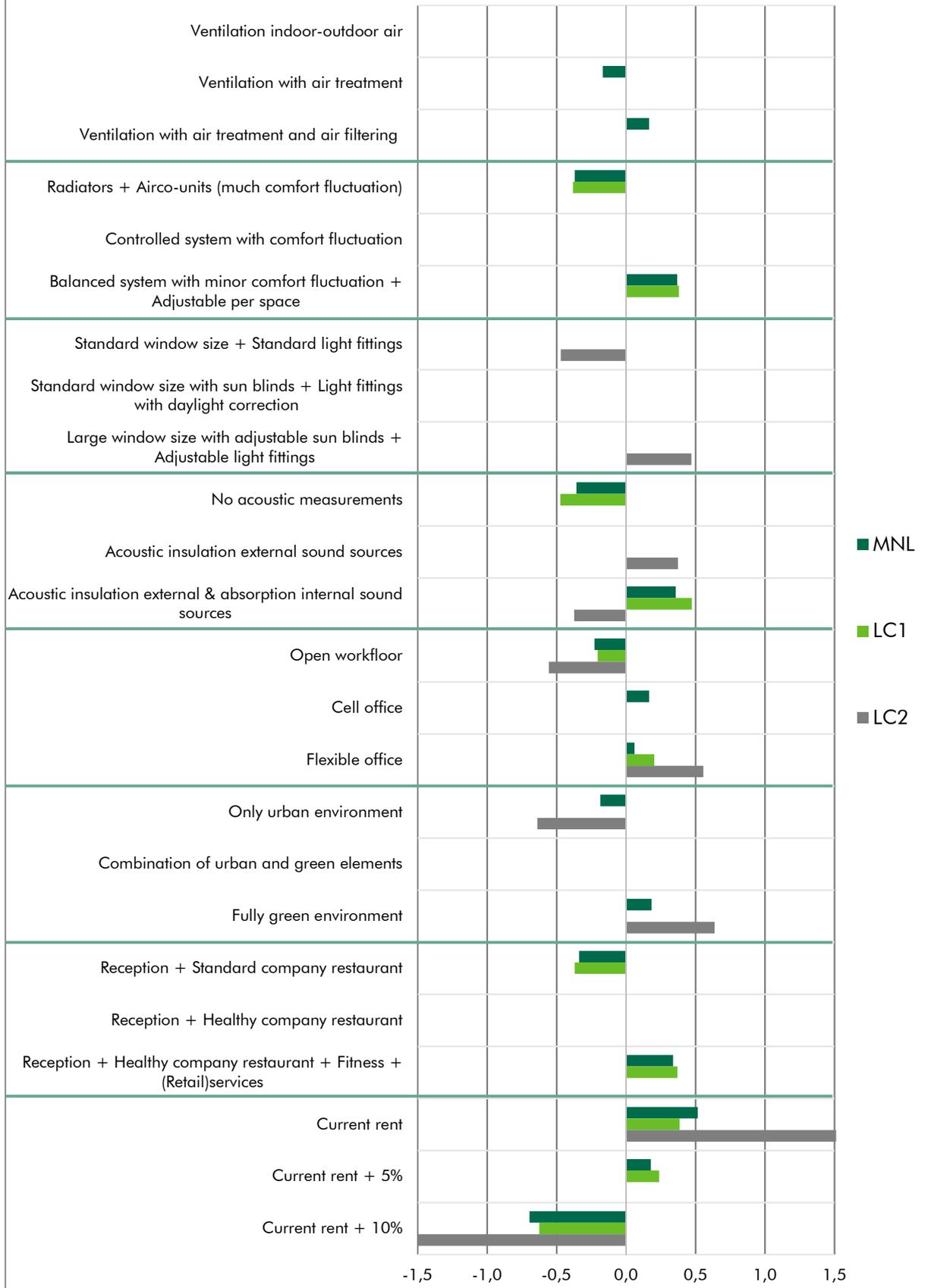
Figure 24. Overview of all significant utility values for all attributes for the MNL and LC models.

With the allocation of respondents to class 1 or class 2, the statistics of demographic and organizational characteristics that were also included in the questionnaire can be derived per class. However, it is only interesting to derive statistics of characteristics that differ per class. In order to identify these differences, chi-square tests are performed of which statistical details of all tests are shown in table 12 and total statistics in appendix P. Again, the Chi-Square tests are subjected to the precondition that no more than 20% of the expected count is less than five and the minimum expected count is at least one (McHugh, 2013). Furthermore, the same sub variables are used as the Chi-Square tests among all organizational characteristics as well as there are no tests performed for the sub questions of the health policy and strategy question since too less statistics are available there to meet the precondition. When the test did not meet the precondition, the statistical details are not given, indicated by an empty row. When a chi-square test between the class variable and another variable is significant, there is statistical difference between the characteristics of class 1 and class 2 of that particular variable. The Chi-Square tests that are significant are marked with the letter [Y] (Yes). The Chi-Square tests that are insignificant are marked with the letter [N] (No). When the Chi-Square tests did not meet the precondition, it is marked with a [-]. The coding of variables explained in appendix H.

Table 12. χ^2-tests comparison of the classes with variables (Class 1: N=47, Class 2: N=37)

*	Gender	Gender_M_F	Age	InfluenceDM	Building	BuildingCity	BuildingTenants	BuildingSize	Lease	Lease_Dir_Ind	FTE	FTE_S_M	FTE_Org	Focus	Sector	Sector_Less	Maturity	Mature_Y_N	HStrategy	HStrategy_Y_N	Promoting_M&S	Innovation	EmployeeSatisfaction	Productivity	Flexibility	CostEfficiency	Sustainability
Class	-	N	-	N	-	-	N	Y	N	N	-	Y	N	N	-	Y	N	N	N	N	N	N	N	N	N	N	N

As shown in table 12, there are identified three variables of which significant differences between classes have been found at the Chi-Square tests on 1%, 5% or 10% level. All variables that indicate differences between classes and will further be analyzed per class:

- The building size of the office building where the organization currently lease office space, χ^2 (2, N = 84) = 8.679, $p < .05$;
- The number of people of (the part of) the organization that work on average per day in the relevant office building (based on FTE), divided into two groups χ^2 (1, N = 84) = 4.734, $p < .05$;
- The sector to which the main activity of the organization belongs to, divided into four groups χ^2 (3, N = 84) = 11.297, $p < .05$.

For the above characteristics, descriptive statistics are generated per class and visualized in the graphs of figure 25, figure 26, and figure 27. Their corresponding cross tables are given in appendix Q.
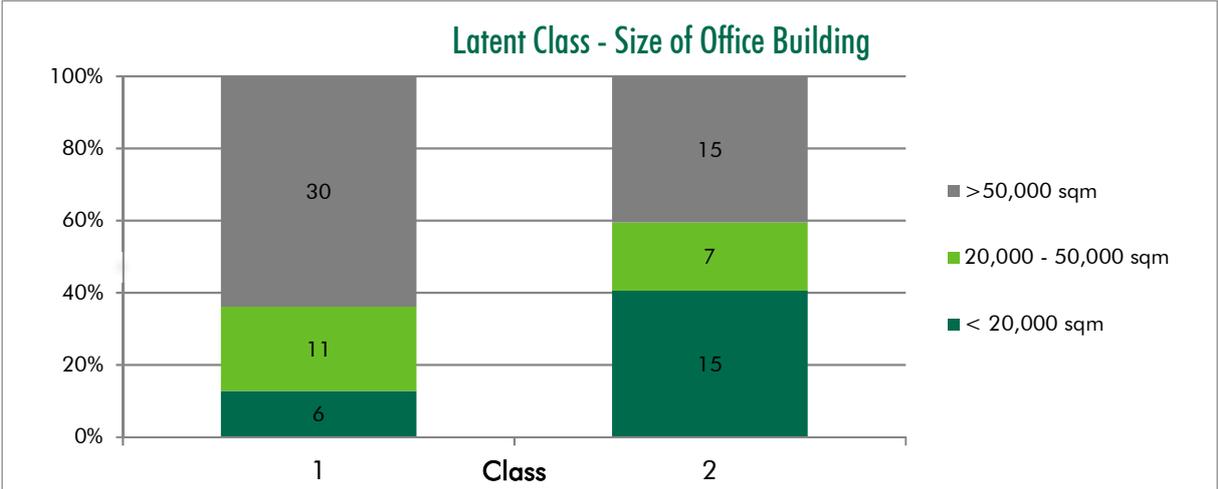

Figure 25. Class differences of office building on 5% significance level (Class 1: N=47, Class 2: N=37)

Figure 17 shows the distributions of both classes in terms of the office building wherein the assigned respondents are leasing office space. It shows that more respondents of LC1 are leasing in the larger multi-tenant business centers in the sample which are WTC Amsterdam, Nieuw Amsterdam Gebouw and WTC Schiphol. The smaller office buildings in the sample are more likely to belong to LC2. Unfortunately, there is not identified a middle level with for instance the buildings Delftse Poort, UP office building and WTC Utrecht because the precondition of the Chi-Square tests were not met when integrating this level.
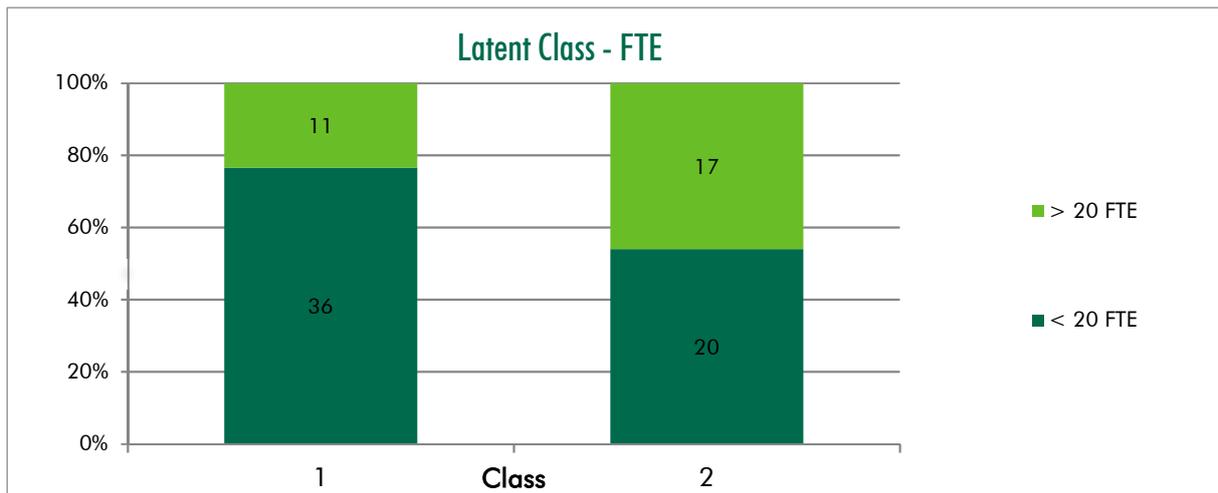
Figure 26. Class differences of FTE on 5% significance level (Class 1: N=47, Class 2: N=37)

The distribution of both classes regarding the amount of FTE that is working in the office space that the tenants are leasing is displayed in figure 18. As can be seen, LC1 generally distinct in smaller tenants and LC2 in larger tenants.
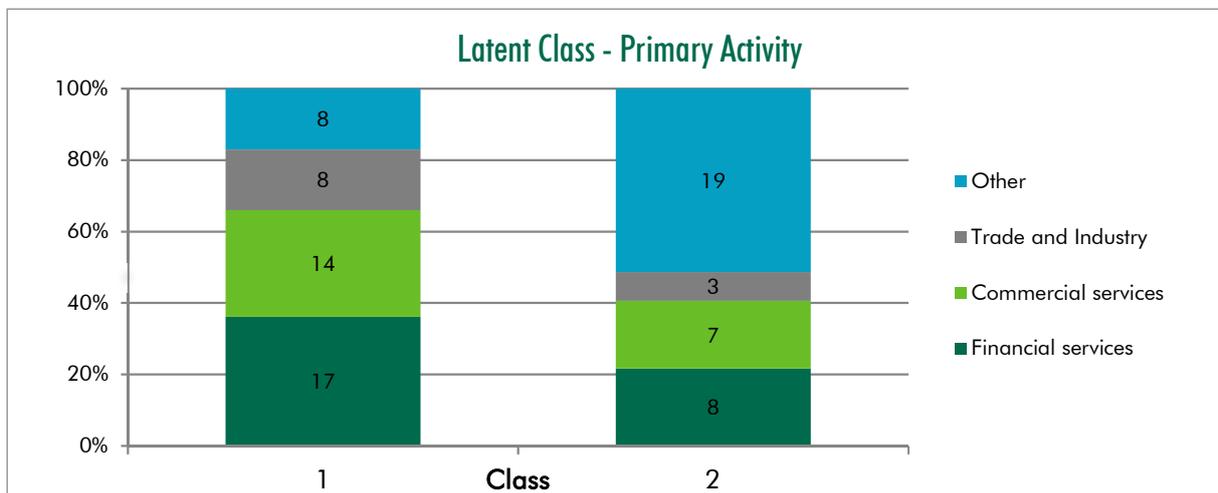

Figure 27. Class differences of primary activity on 5% significance level (Class 1: N=47, Class 2: N=37)

The class distribution of the sector to which the primary activity of the organization belongs is given in figure 19. LC1 is more represented by financial services, commercial services as well as trade and industry. LC2 is represented more by organizations that operate in other (service) activities, including governmental and ICT organizations.

5.5 CONCLUSION

The explorative research was outlined in this chapter. First, the data collection of the survey and its data preparation was elaborated whereafter the data analyses were described with the descriptive statistics and the results. That makes it possible to answer on the sub research questions *'What are the preferences of office tenants for particular health aspects in offices?'*, *'How much are office tenants willing to pay for particular health aspects in offices?'* and *'Which market segments of office tenants can be distinguished with regard to preferences and willingness to pay for particular health aspects in offices?'*. An overall preference regarding trade-offs between healthy office workplace aspects is estimated through their relative importance indicating that thermal comfort, noise & acoustics and provisions are relative of more importance when making office workplace decisions. The preferences for those aspects are higher for healthier office workplace characteristics. Office type, view and indoor air quality are slightly less important when making office workplace decisions and the preference for their office workplace characteristics proportionate differently. So is the medium health quality level of office type preferred above the high health quality level and is the indoor air quality merely preferred on the high health quality level, although preferences for view are higher for healthier office quality levels. Only exposure to light has been found to not play a role in office workplace decisions for the sample of this study, so no preference could be estimated for that aspect.

The rental price is estimated to have dominant importance over all healthy office workplace aspects in the variation of this study, meaning that the price is considered the most when making office workplace decisions that include healthy office workplace aspects. In general, higher rental prices are disliked. Nonetheless, there exists willingness to pay for higher rents for all healthy office workplace aspects except exposure to light. The willingness to pay for almost all aspects is the highest when improving from a low health quality office to a high health quality office and lower when making the improvement from a low health quality office to a medium health quality office or from a medium health quality office to a high health quality office. Only the willingness to pay for the attribute 'Indoor Air Quality' is higher when improving a medium health quality office to a high health quality office and for 'Office Type' is the WTP from a low to medium health quality office workplace higher than the other improvements. Moreover, the willingness to pay for 'Office type' is negative when changing from a low health quality office to a medium health quality office as well as the change from medium to a high health quality office workplace of 'Indoor Air Quality'.

Furthermore, two market segments are estimated from the sample which has different preferences for healthy office workplace aspects. The segment that consists of smaller tenants in larger office buildings which are more operating at financial services, commercial services as well as trade and industry, has more preference for healthier levels of thermal comfort, noise & acoustics, and provisions. In addition, that segment is more willing to pay for the office workplace characteristics they prefer. The other market segment lease more in smaller office buildings and consists of larger tenants as well as organizations that operate in other (service) activities, including governmental and ICT organizations. This market segment has more preference for healthier levels of light exposure, office type and view, but is less willing to pay for their preferred office workplace characteristics.

6. CONCLUSION, LIMITATIONS & IMPLICATIONS

The goal of this research was to identify which healthy office workplace aspects are beneficial to invest in by landlords through investigating preferences of tenants regarding trade-offs between particular healthy office aspects. This goal is pursued in different research phases that provided outcomes within the scope of the research. In this final chapter, the outcomes of the entire research are addressed in order to make conclusions based on the preset research questions. Furthermore, the discussion and limitations of the research outcomes are described as well as recommendations for future research are given. Moreover, the practical implications of this study's generated knowledge are provided.

6.1. CONCLUSION

The conclusion of this research intends to answer the main research question that is set up in the first chapter of this thesis, being *'Which healthy office workplace aspects that are relevant for landlords are preferred by office tenants and how much are they willing to pay for the implementation of particular aspects?'*. In order to find the answer to the main research question, four sub questions were set up. This section provides the conclusion of the research by answering these sub questions that make it eventually possible to answer the main research question.

The preliminary research about healthy office workplaces of chapter 2 answers the sub question *'What is the healthy office workplace and which aspects can be influenced by landlords?'*. The literature study indicates that the attention for health in the office workplace originates from deteriorated health due to changing use of office environments as well as raising awareness that offices can affect the health of workers inside them. Since the key asset for most organizations is their human capital, the outcomes of a healthier workforce can be substantial through providing the best office workplace circumstances. It became clear that a healthy office workplace does not only provide protection for workers from physical health risks such as accidents, injuries or sickness that lead to absenteeism and presenteeism including spillover effects on colleagues. Additionally, the healthy office workplace does also promote positive health that leads to increases in workers' job satisfaction, morale, commitment and motivation. In turn, organizations profit from higher productivity, organizational effectiveness, competitive advantages and positive influences on attracting and retaining talent. These organizational performance outcomes can increase the demand of organizations for healthy office workplaces. That can be interesting for landlords since they normally rent office space to organizations and they can substantially influence the quality of the office workplace of their properties. In that way, investing in healthy office buildings can be beneficial for landlords by charging higher rents for the better quality of the building. Likewise, vacancy can be less due to quicker lease-up accordance and retaining tenants which in turn can lead to lower future replacement investments and higher building valuations.

A healthy office workplace is defined as the optimum alignment of the totality of workplace aspects that protect and promote physical health, mental health and social health of the workers inside the office with the purpose to maximize the performance of the organization's human capital. Within these health components, confusing terms are interpreted as a part of physical health, mental health or social health. So is safety interpreted as preserving physical health, the feeling of safety is interpreted as preserving mental health, stress is influencing negative mental health and wellbeing is influencing positive mental health. An in-depth literature study is executed to identify which office workplace characteristics influence particular health aspects. From that study, seven aspects are selected that can be influenced by landlords, being (1) 'indoor air quality', (2) 'thermal comfort', (3) 'exposure to light', (4) 'noise & acoustics', (5) 'office type', (6) 'view' and (7) 'provisions'.

The second part of the preliminary research is treated in chapter 3 and found answers on the second sub question *'What are the aspects that influence organizational decision making for office workplace accommodation?'*. With the aid of general decision making theory, the scientific perspective of organizations towards decision making is identified. It turned out that the characteristics of the background of decision makers (states) are relevant to the decisions that can be made (alternative acts) and thus can influence the preference (outcome) of a decision maker. The literature study identified which 'states' can influence organizational decision making for office workplace accommodation. Based on that study, a categorization is made between organizational characteristics, building characteristics, location characteristics and rental price. Moreover, 'states' of policies and strategies that indicate awareness of health in the workplace are investigated. The primary activity, size, maturity, focus and purpose of accommodation have been found to be influential organizational characteristics as well as interventions for preservation and promotion of health and motivations of organizations not to invest in it. Building characteristics that influence organizations' office workplace accommodation are various and in literature indicated by push, pull and keep factors. Moreover, the identification of building characteristics can be specified by the business center concept. Location characteristics

can be segmented 'soft' characteristics which are more qualitative, 'hard' characteristics which are more geographical and demographical characteristics of a region. The rental price is also of influence and reasonably determined by the demand and supply of all circumstances in the office market.

The description of the methodology in chapter 4 described the research design of the explorative research of which execution and results are described in the data analysis of chapter 5 in order to answer the third sub question '*What are the preferences of office tenants for particular health aspects in offices?*'. A Stated Choice Experiment (SCE) is utilized to be able to answer this sub question. To conduct the experiment, the seven office workplace aspects that were identified in the preliminary research were refined into seven attributes with three attribute levels each that follow ordinal qualitative scales which are relatively applied in offices with a low, medium and high health quality. The experiment was executed with an online questionnaire that included the SCE as well as questions that were based on aspects that influence organizational decision making for office workplace accommodation which were selected within the focus of this research. The online questionnaire is distributed among decision makers of office tenants of the CBRE Dutch Office Fund and completed by 84 respondents.

At first, the data that is generated with the online questionnaire is analyzed with a Multinomial Logit (MNL) model. The MNL model indicates slight heterogeneity in the sample, but nonetheless, its estimates are appropriate to draw conclusions. The attribute level coefficients that are significant play a role in office workplace decisions and make it able to estimate relative importance between healthy office workplace attributes. Thermal comfort, noise & acoustics and provisions are of relatively high importance in making office workplace decision, of which all indicate higher preference for healthier office workplace characteristics. Office type, view and indoor air quality show less importance but still play a role. Among them, preferences are higher for healthier view characteristics while indoor air quality is merely preferred on the high health quality level and office type is more preferred on the medium health quality level above the high health quality. Exposure to light is insignificant and thus does not play a role in office workplace decisions in the scope of this study.

The investigation with Latent Class (LC) models estimated two market segments in the sample that affect the preference for healthy office workplace attributes differently. The characteristics of respondents' backgrounds that are also investigated in the questionnaire were allocated to these market segments via Chi-Square tests to estimate differences in the backgrounds of these segments. One market segment (LC1) consists of smaller tenants in larger office buildings which are operating at organizations of which activities are more in financial services, commercial services as well as trade and industry. That segment has more preference for healthier levels of thermal comfort, noise & acoustics, and provisions. The other market segment (LC2) leases more in smaller office buildings, consists of more larger tenants that operate in other (service) activities, including governmental and ICT organizations. This market segment does especially have preference for healthier levels of light exposure, office type and view.

Because the SCE also included the attribute (8) 'rental price' that consists of attribute levels that assume values of rental prices relative to the current rental price of office space, it is able to estimate the Willingness to Pay (WTP) for healthy workplace attributes by calculating the ratios between attribute level coefficients. The WTP-values make it possible to answer the fourth sub question '*How much are office tenants willing to pay for particular health aspects in offices?*'. With the use of the MNL model, the relative importance of the 'rental price' is also calculated against all other attributes. The relative importance of the rental price is the highest among all attributes meaning that the rental price is of great importance in office workplace decisions wherein healthy office workplace characteristics are considered. The preference for rental prices generally decreases at higher values. The calculations of WTP-values provide more profound information when considering utility differences between attribute levels. It became clear that for all significant attributes except indoor air quality, the highest WTP derives when improving an office with a low health quality to an office with a high health quality. Those highest WTPs are estimated for respectively thermal comfort (6.25%), noise & acoustics (5.90%) and provisions (5.60%), while lower WTPs are estimated for respectively view (3.14%) and office type (2.39%). The improvements from an office with low to a medium health quality as well as from a medium to a high health quality follows comparable sequence but with lower WTP values, with an exception for indoor air quality since that attributes' highest WTP concerns the improvement from a low to a medium health quality (2.95%). This indicates that the sample was generally willing to pay more for healthier office workplace attribute levels, except for exposure to light since that attribute was not significant. Furthermore, a WTP-range for improving an office workplace quality as a whole is calculated as the difference between a conservative minimum (weighted average) and an optimistic maximum (sum of the parts) that included all aspects. The calculation estimated a WTP range from a low to a medium health quality office of 6.37 – 12.33%, from a medium to a high health quality office of 6.17 – 12.43% and a low to a high health quality office of 12.54 – 24.76%.

The investigation of the Latent Class (LC) model answers the fifth sub research question '*Which market segments of office tenants can be distinguished with regard to preferences and willingness to pay for particular health aspects in offices?*'. The model estimates indicate that the WTP differs between the two segments. Market

segment LC1 is generally more willing to pay for healthy office workplace aspects than market segment LC2, although differences exist between WTP for specific attributes. LC1 shows more WTP for healthier levels of thermal comfort, noise & acoustics, and provisions, while LC2 shows higher WTP values for healthier levels of light exposure, office type and view.

Now the sub questions are answered, it is possible to answer the main research question of this thesis: *'Which healthy office workplace aspects that are relevant for landlords are preferred by office tenants and how much are they willing to pay for the implementation of particular aspects?'*. The tenants in the total sample consider all healthy office workplace aspects that are identified in the preliminary research of interest, except 'Exposure to light'. These aspects are respectively 'Thermal comfort', 'Noise & Acoustics', 'Provisions', 'Office type', 'View' and 'Indoor Air Quality'. Of those aspects, the tenants are willing to pay more for healthier office workplace characteristics in a range from 1.48%-6.25% when improving an office with a low health quality to an office with a high health quality and up till 3.14% when improving offices from a low to medium health quality or from a medium to a high health quality. When considering the office workplace as a whole including all significant healthy office workplace aspects, the WTP range from a low to a medium health quality office is estimated at 6.37 – 12.33%, from a medium to a high health quality office at 6.17 – 12.43% and from a low to a high health quality office at 12.54 – 24.76%. A further distinction of tenants' preferences for aspects is found between two segments which differ in a few organizational characteristics. It shows that on the one hand smaller tenants in larger office buildings which are operating at organizations of which activities are more in financial services, commercial services as well as trade and industry, are more willing to pay in general for healthier workplace aspects and show higher WTP for thermal comfort, noise & acoustics, and provisions. On the other hand, larger tenants that lease more in smaller office buildings and operate in other (service) activities, including governmental and ICT organizations are generally willing to pay less for healthier workplace aspects, but show higher WTP for exposures to light, office types and views that are healthier.

6.2 DISCUSSION

This study makes several contributions to the research field of the healthy office workplace. First, it made theoretical contributions by examining the entirety of healthy office workplace aspects within landlords' influence of which selection is made on clear classification principles. This is done by combining findings of existing literature that mainly identified the effect of single workplace characteristics on particular office workers' health outcomes (table 2). The findings of those studies seem convenient since the found effects in all examined literature show less striking relationships between healthy office workplace characteristics and workers' health. Nonetheless, there are former studies that searched for relations between conjoint office workplace aspects and health outcomes (table 1) but these focus on office users.

Furthermore, this is the first study that approaches healthy office workplace aspects from the direct perspective of tenants by investigating their preferences. Therefore it was also possible to incorporate a WTP-measure for healthy office workplaces for the first time. Former studies are mostly conducted from the perspective of office users, which are indirect stakeholders in decision making about office workplace accommodation. Because this study considered preferences of decision makers, the results provide knowledge that can be used to justify implementations of healthy office workplaces. That is done through investigating preferences of tenants regarding trade-offs between particular healthy office workplace aspects including a monetary factor. Nonetheless, there are studies that show comparable trade-offs between workplace aspects with regard to office occupant satisfaction (Huang, Zhu, Ouyang, & Cao, 2012) (Hartog, Weijs-Perrée, & Appel-Meulenbroek, 2018) and productivity (Attema, Fowell, Macko, & Neilson, 2018) but these do not consider health outcomes. This can be explained by the relatively new development about the way of thinking that organizations' can benefit from better health of their workers. Notwithstanding, these studies are interesting to consider since they show equal sequences of trade-offs when filtering out the healthy office aspects that are included in this study and reflect them to the parameters of the MNL and LC models. But also other studies provide reflection of the results of this study. On the one hand, the aspects 'Thermal comfort' and 'Noise & Acoustics' are in this study found to have the highest preference among tenants of which similar relations are found in the study of Huang et al (2012) that state that both have a one-vote veto power over the satisfaction levels of the indoor environment in offices as a whole. 'Provisions' are found to have the third preference in this study which complies as a regularly mentioned aspect in studies about building characteristics as push, pull and keep factors (Pen, 2002) (Pellenbarg, 2005) (Appel-Meulenbroek, 2008) as well as location characteristics (Remøy, Koppels, Van Oel, & De Jonge, 2007), (Jansen, 2009). The 'Office type', being the fourth most preferred office workplace characteristic among tenants in this sample, is also found in multiple studies strongly influences workers' preferences and sometimes even associated with higher satisfaction levels of IEQ factors (De Croon, Sluiter, Kuijer, & Frings-Dresen, 2005) (Candido, et al., 2016). 'View' is difficult to relate to the other aspects since it is not often mentioned in studies with combined workplace aspects which may indicate its relatively low preference among the office tenants in this sample. On the other hand, the low preference for 'Indoor Air

Quality' seems striking with former research. So does literature indicate that indoor air quality is considered of high importance among other office environment aspects (Roelofsen, 2002) (Al Horr, et al., 2016), although Huizenga et al (2006) state that much occupants are satisfied with the indoor air quality. Moreover, all attribute level coefficients of 'Exposure to light' are insignificant, indicating that no difference is found between preferences of light characteristics in office workplaces. This is also contradictory to findings in existing literature that argue that light does effect office worker preferences, especially to those which indicate preference of light over other attributes (Lamb & Kwok, 2016). Despite that, it is plausible that preferences and relative importance for 'Indoor Air Quality' and 'Exposure to light' are lower since in the Netherlands both aspects have fairly good basic principles by law (Bouwbesluit 2012) and thus often already well implemented in office buildings. In that context, respondents may have more preference for healthier office workplace characteristics of aspects where they generally are less satisfied with.

In general, the trade-offs provide information for future research to focus on the most preferred aspects or just to give attention to the less preferred. But this study also provides plenty of opportunities for replication studies in this under-researched area since the methodology can be implemented in other circumstances such as other countries and other types of office(s) (funds) to examine whether preferences for aspects differ across populations. In that context, the identification of underlying structures of organizational characteristics and the office market towards health through identifying market segments is even more insightful.

When comparing this study with former studies that identified aspects that influence organizational decision making for office workplace accommodation, this study makes a contribution by deepening and broadening the totality of building characteristics by adding healthy office workplace characteristics. So does the study of Remøy & Van der Voordt (2014) not interpret aspects of the indoor environment quality (IEQ) as this study but from the context of appearance and maintenance state, is view not taken into consideration and are building provisions that specifically foster worker' health not mentioned. Appel-Meulenbroek (2008) does not consider views, office type and provisions that focus on worker's health and the study of Weijs-Perrée et al (2016) that compared business centers does not mention aspects of indoor environmental quality at all as well as provisions towards worker' health. The studies of (Pen, 2002) and (Pellenbarg, 2005) about push and pull factors that determine migration of firms do not go in-depth of building qualities or facilities at all.
In that context, an important note for this study is that characteristics that were not included in this experiment were kept constant (ceteris paribus). This may imply that other effects, such as effects in the above mentioned studies, still influence organizational decision making for office workplace accommodation and thus can affect the model estimates of this study differently when integrating them.

In a broader context, limited research that includes a comprehensive look at office workplace health is conducted yet. Therefore, it is possible that some effects were not measured in the right way. This is a main challenge because a holistic approach is almost not achievable since only personal health is already influenced by a lot of factors that do not deal with the workplace itself (Wierzbicka, et al., 2018). There are limited case studies or experimental environments in practice to investigate since the implementation of total healthy office concepts are still rare, especially not over a longer period. When these are available to conduct in future, it is recommended to perform these to reveal hypothetical effects and search for unrevealed effects.

6.3 LIMITATIONS & RECOMMENDATIONS
Both the findings of the preliminary research and the outcomes of the explorative research have limitations that are discussed in this section. The results of the preliminary research can limit this study by the found literature within the research field and the focus of this study. Among the studies that investigate the relationships between single office workplace characteristics and particular health outcomes, it is possible that there are office workplace characteristics or outcomes not identified or not researched yet. In that case, the focus of this research let them out of consideration and let (interaction) effects unrevealed. That also counts for (holistic) health effects in general because it is barely able to measure it as a whole due to its dependency on a wide variety of circumstances of which this thesis only includes the influence of office buildings. The contribution of health outcomes due to office workplace characteristics to organizational performance contains a similar measurement uncertainty. In that context, the influence of the landlord on worker's health is very challenging to find. Therefore, it is recommended for further research to investigate for instance a trade-off between contributions of health outcomes due to office workplace characteristics to organizational performance to determine which office workplace characteristics really matter. Besides the identification of relations between office workplace characteristics and office workers' health, also characteristics of tenants of multi-tenant business centers are identified that relate to their organizations' decision making of office workplace accommodation. That identification seems convenient in the focus of this research, but it is possible that characteristics miss due to lack of studies or wrong queries.

The healthy workplace aspects and the aspects that influence organizational decision making for office workplace accommodation that are chosen to further investigate in the explorative research (table 1 and section 4.3) may also have limit this study. Although the aspects are deliberately chosen, it is possible that interaction effects between the selected aspects exist or that aspects that were left out of consideration eventually fit within the focus of this research.

The results of the explorative research are limited by the response rate of approximately 15% as well as the total number of 84 respondents. These amounts are slightly low which may have led to the underrepresentation of certain types of respondents which in turn have effect on the generalization of the sample. Nonetheless, when generalizing the results of this research' focus to other real estate funds or the Dutch office market as a whole, the type and the size of the sample is different because there is great variety of tenants that are renting office space in a big diversity of office buildings across the country. Therefore it is recommended to repeat a similar study that includes a larger sample size with a broader focus of office tenants. Such a larger sample probably makes it also possible to distinguish more latent classes among which more statistical differences could be found between characteristics that influence tenants' decision making of office workplace accommodation.

The generalization of the results of this study to office markets outside the Netherlands is for similar reasons reasonably difficult. Although the preliminary research is based on knowledge around the world that suggests global awareness of the healthy office workplace, the findings of the explorative research are difficult to generalize for every country. This is because every country has divergent types of organizational cultures, distinct use of office workplaces and other (office market) circumstances where organizations are operating in. When performing similar research in another country, it is recommended to refine characteristics that influence tenants' decision making of office workplace accommodation again.

Also, attributes often contain one insignificant attribute level coefficient. These limited significance coefficients may have been caused by losses of attention during the SCE or by potential misinterpretations of that attribute levels. So might the sequence of the questionnaire cause limited significance coefficients due to attention losses as well as it is possible that respondents had too little knowledge or awareness to fill in the questionnaire and therefore made no relevant choices in the SCE. Although this research focused on decision makers of their organizations' office workplace accommodation, some of them might not have enough knowledge of the attributes and attribute levels as well as they might not be aware of the influence of the attributes and attribute levels on workplace health. It is tried to identify this limitation with the question about policies and strategies regarding workers' health of which 16.7% did not know whether their organization implemented an employee health strategy or policy. That indicates a low awareness of health in the workplace among those respondents. Also the questions that should reveal respondents' views on their current workplaces show that up till 14% of respondents did not know which attribute levels there are applicated in their own offices. Since that were also the attribute levels that included in the SCE, it is not sure whether respondents had enough knowledge to decide on the hypothetical office workplace. Future research might reconsider the thermology and length of attribute level labels as well as include more control questions about health awareness in the questionnaire.

In terms of the WTP-attribute, limitations can exist around the quantity of the attribute levels. Although the found results seem relatively logical since the WTP is higher for outcomes that are generally more preferred by respondents, it is not sure if the same sizes appear when other rental price scales were served to respondents. In the stimuli refinement, there is chosen to include assumptions of the rental price plus 0%, 5% or 10%. Other assumptions could have influence respondents' choices and thus the outcomes of the WTP attribute utilities and calculations. Moreover, lower rental price values than the current rent are not included in the experiment but could also have influenced WTP attribute utilities differently when they were included. For those reasons, a recommendation for future replication research is to identify a range of assumptions through preliminary research among tenants.

Additional limitations concern the interpretation of the decision makers that form the respondents in this research, which are determined by the contact persons of the concerning real estate fund. These people are mostly tenants' representatives with who the rental agreement is negotiated or facility managers of tenants. It is identified that only 10.7% of the sample is individually responsible for decisions of real estate accommodation, which indicates that the rest of the sample has other colleagues that represent their organizations which maybe would have answered the questions (a bit) differently. In that context, it is questionable whether a SCE represents the 'indirect' preference of an organization well via representatives since SCEs are often used to investigate 'direct' preferences of individual consumers.

Besides it is identified that representatives differ in influence on real estate decision making within their organizations, there are also people that can influence the choice for health in the office workplace while not having professionality in real estate. Regarding the fact that organizations are highly dependent on their human capital, human resource managers could play this role since healthy offices nurture human resources. Therefore

it is a recommendation for future research to also identify the perspective of human resource managers in order to compare these to general decision makers of office workplace accommodation.

Furthermore, it is likely that tenants that strive for the best workplace have higher WTP than the ones that only do what is obligatory and profitable. In that context, it is likely that both profiles have interpreted surveys differently. That is because the ones that probably know the concept and considers their workers' health as important and want to improve it. It is easier to motivate them to complete the survey because they want a healthy office building and feel for participating in research that considers it. The others probably only consider health when they are convinced by profitability based on evidence which was not completely existent on the moment of research. Therefore it is recommended for future research to investigate more detailed background of tenants' knowledge about health in the office workplace and what their motivations are to consider it or not. In addition, this research is set up with the objective to identify which healthy office workplace aspects are beneficial to invest in by landlords through investigating preferences of tenants regarding trade-offs between particular aspects within the influence of landlords. To shift from beneficial to profitable, a business case is needed. Therefore, it is recommended to perform case studies on expenditures of healthy office aspects as well as to make estimations of actual tenancy of healthy offices, so integrated (business) models can be set up. Such models should also include for instance the property's life cycle phase that often is another driving force when expending capital to improve buildings.

Last, it is interesting to identify revealed preferences via other research methods to distract WTP over time. Relevant examples therefor are given in section 4.1. This is possible when there is more data available in future when healthy office workplaces are implemented frequently in practice. The real-world decisions of revealed choices possibly map more external influences.

6.4 PRACTICAL IMPLICATIONS

The practical contributions to the real estate market of this study are various. Because it considers the perspective of tenants within the influence of landlords, which both are important stakeholders in the office market, it contributes to underpin the business case for the implementation of healthy office workplace concepts. The findings are in particular useable for real estate investors, asset managers and developers because the findings implicate which healthy office aspects they can apply in their projects are the most beneficial to invest or innovate in. The results of this study guide them in which healthy office aspects must be given priority against others in order to add maximum investment value for future leasing or selling of their properties. In addition, the market segments that are distinguished can provide information when real estate investors, asset managers or developers are focusing on attracting or retaining specific tenants of which class preferences have been found. That also implies for negotiating with tenants about (renewal of) lease agreements or about capital expenditures in the office buildings tenants rent. In that context, this study suggests that it is beneficial to focus more on smaller tenants which prefer to lease office space in larger office buildings which are operating at organizations of which activities are in financial services, commercial services as well as trade and industry.

The preliminary research contributes to the insight of tenants whenever they would like to identify which office workplace characteristics contribute to which specific health outcomes, so they know how to improve their workers' health by their office workplace. In that context, this study contributes also to their insight on how they have to collaborate with the landlords when they want to applicate specific improvements of workplace characteristics that are of influence of the landlord.

Furthermore, the effect of a healthy office workplace goes further than the focus of this research since it only focusses on the influence of landlords. If the leased space that is of influence of tenants is not used well or is lacking in quality, the positive health effects that are provided by the landlord can be diminished. Therefore, engaging office workplace occupiers is essential for keeping a building healthy. This can be stimulated by for instance providing communication packages to tenants that inform and guide them and their workers how to use and inhouse and fit-out the workplace as good as possible after transaction, but also organizational measures that can be taken to encourage healthy behavior of occupants. In turn, also property managers should be informed about pro-actively preserving the qualities of service and maintenance of all healthy building aspect characteristics.

In the previous section, it is stated that it is likely there are two profiles of tenants. A future challenge is to activate the group of tenants that only does what is obligatory and profitable for their organization. This might be done by involving the human resource departments of those organizations. Their views on the office workplace may stimulate decision makers of office workplace accommodation through raising their awareness of the outcomes. It may be possible for instance that such departments can financially contribute to healthy workplace expenditures since the benefits are mostly in advantage of that department.

Also, the relationships between organizational characteristics provided some interesting practical implications when it comes to the amount of FTE of tenants in their leased space. That is because the dependencies among

the amount of FTE in tenants' leased space and other descriptive statistics indicate that such tenants have less often incorporated a health policy or strategy. Moreover, smaller tenants are more likely to lease serviced offices, are relatively less mature organizations and generally have low stakes of their workers in that office space related to the whole organization or just almost the whole organization. Those relationships may imply that small organizations or small parts of big organizations that consist of fewer workers are more willing to outsource the accommodation of a healthy workplace to third parties. Since their direct workforce is small, they probably have no human resources that focus on such implementations. It can be beneficial for landlords to focus on that group when implementing healthier office workplaces in their office buildings.

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APPENDICES

Appendix A. Orthogonal design of Stated Choice Experiment based on 27 profiles of eight attributes with three levels each.

Nr	A1	A2	A3	A4	A5	A6	A7	A8
1	0	0	0	0	0	0	0	0
2	0	0	1	1	1	2	1	2
3	0	0	2	2	2	1	2	1
4	0	1	0	0	1	1	2	2
5	0	1	1	1	2	0	0	1
6	0	1	2	2	0	2	1	0
7	0	2	0	0	2	2	1	1
8	0	2	1	1	0	1	2	0
9	0	2	2	2	1	0	0	2
10	1	0	0	1	1	1	1	1
11	1	0	1	2	2	0	2	0
12	1	0	2	0	0	2	0	2
13	1	1	0	1	2	2	0	0
14	1	1	1	2	0	1	1	2
15	1	1	2	0	1	0	2	1
16	1	2	0	1	0	0	2	2
17	1	2	1	2	1	2	0	1
18	1	2	2	0	2	1	1	0
19	2	0	0	2	2	2	2	2
20	2	0	1	0	0	1	0	1
21	2	0	2	1	1	0	1	0
22	2	1	0	2	0	0	1	1
23	2	1	1	0	1	2	2	0
24	2	1	2	1	2	1	0	2
25	2	2	0	2	1	1	0	0
26	2	2	1	0	2	0	1	2
27	2	2	2	1	0	2	2	1

Introduction
Dear tenant,

Thank you for participating in this research. The following questionnaire is part of my graduation thesis for the master Urban Systems & Real Estate at the Technical University of Eindhoven and focuses on the healthy office environment.

If you have any questions or comments regarding the research or this questionnaire, please contact me at w.buskermolen@student.tue.nl or +31 622013254.

Sincerely,
Wietse Buskermolen

Data protection Statement
"I declare that I am participating voluntarily in this research and that I am aware that at any point in time I have the right to quit the survey or withdraw my data without the need of any motivation. The purpose and aim of the study is made clear to me. The collection of data relates to the organization where I work as well as my personal background regarding my gender and age. My retrieved data will be aggregated to group level, evaluated and published for scientific purposes, such as research papers and a graduation thesis. When the research process is completed, my individual records will be deleted by the research team. All data on group level will be kept on secure and encrypted university storage. No third party will have access to my data and only the principal researcher and his team have the right to look into the data. If the data will be made public in any way, all personal information will be completely anonymized. For any additional information I can contact the principal researcher Wietse Buskermolen BSc (w.buskermolen@student.tue.nl) or his supervisors dr.ir. Rianne Appel-Meulenbroek (h.a.j.a.appel@tue.nl), prof.dr. Theo Arentze (t.a.arentze@tue.nl) and dr.ir. Astrid Kemperman (a.d.a.m.kemperman@tue.nl) of Eindhoven University of Technology."

Q0: **"I have read the data protection statement. I am participating voluntarily in this questionnaire."**
O Yes, I would like to participate.
O No, I will end this questionnaire.

Personal background
Q1: What is your gender?
O Male
O Female
O No answer

Q2: What is your age?
O < 17 years
O 18 - 29 years
O 30 - 49 years
O 50 - 65 years
O > 65 years

Q3: To which extent do you have influence on the decision-making of the real estate accommodation of the organization you work for?
O I am individually responsible
O I am responsible with other people that work at my organization
O I do not have responsibility, but I can influence the decisions that are taken
O I do not have influence on decisions that are taken (I am only an user of a workplace)

Q4: In which office building does your organization rent office space?
O WTC Amsterdam
O Nieuw Amsterdam Gebouw
O UP office building
O NoMa House
O WTC Schiphol
O WTC Utrecht
O Hojel City Center II
O Sypesteyn
O Delftse Poort

Q5: Does your organization rent office space directly from the owner of the building or via The Office Operators (TOO)?
O Owner (landlord)
O The Office Operators (TOO)
O Other / I don't know

Q6: How many people in your organization work on average per day in this office building (based on FTE)?
O 0 – 10 FTE
O 10 – 20 FTE
O 20 – 50 FTE
O 50 – 100 FTE
O > 100 FTE

Q7: How does the above number of FTEs in this office building relate to the total size of the organization?
O < 25%
O 25 - 75%
O 75 - 100%
O 100%

Q8: Which of the focus values below fits the most to (the part of) your organization that uses the rented office space?
O Costs & efficiency of business operations
O Customer oriented & product quality
O Creativity & innovation
O None of the above

Q9: Which purpose(s) mentioned below serve as a starting point for choosing the office accommodation of your organization of the rented office space? *Select the 3 most appropriate answer options.*
O Promoting marketing and sales (customers, recruitment)
O Stimulating innovation
O Increasing employee satisfaction
O Increasing productivity
O Flexibility of rental agreement
O Cost efficiency
O Sustainability (socially responsible)

Q10: To which sector does the main activity of the organization for which you work belong?
O Agriculture, forestry and fishing
O Mining and quarrying
O Manufacturing
O Utility Services
O Construction
O Wholesale and retail trade
O Transportation and storage
O Accommodation and food service activities
O Information and communication
O Financial institutions
O Renting, buying and selling of real estate
O Consultancy, research, legal and other specialized business services
O Renting and leasing of tangible goods and other business support services
O Public administration, public services and compulsory social security
O Education
O Human health and social work activities
O Culture, sports and recreation
O Other service activities
O Activities of households as employers
O Extraterritorial organizations and bodies

Q11: How would you describe the organization for which you work?
O Starting (exists ± 0-4 years)
O Growing – increasing markets (exists ± 4-11 years)
O Mature – (inter)national expansion (exists >11 years)

Q12.0: Has your organization implemented a strategy and / or policy in the field of employee health and well-being?
O Yes
O No
O I don't know

[IF Yes] Q12.1: What measures does your organization offer to promote the health and well-being of employees? *Multiple answers possible*
O Health risk assessment (e.g. biometric screening)
O Self-help education materials
O Individual counseling / coaching (physical / mental)
O Classes, seminars, group activities
O Added incentives for participation (e.g. sport subscription, bike purchase compensation)

[IF No] Q12.2: Why does your organization have no strategy / policy in the field of employee health and well-being? *Multiple answers possible.*
O Lack of budget
O Do not know how to organize or get started
O Insufficient management support
O Lack of business case to support implementation of health strategy
O Insufficient demand of employees
O Belief that managing employee health is not the role of the organization
O Does not meet the image of the organization
O Otherwise […]

Quality of Current office space

Q13: For each aspect, select which characteristic is the most applicable to the <u>current rented office space</u>. Select 'None' if no characteristic applies. Only one option can be selected per aspect.

If you want to read more information about an aspect, move your mouse over that aspect.

ASPECT	Characteristics			
Indoor air quality	Ventilation indoor-outdoor air	Ventilation with air treatment	Ventilation with air treatment and air filtering	None
Thermal comfort	Radiators + Airco-units (much comfort fluctuation)	Controlled system with comfort fluctuation	Balanced system with minor comfort fluctuation + Adjustable per space	None
Exposure to light	Standard window size + Standard light fittings	Standard window size with sun blinds + Light fittings with daylight correction	Large window size with adjustable sun blinds + Adjustable light fittings	None
Noise & acoustics	No acoustic measurements	Acoustic insulation external sound sources	Acoustic insulation external & absorption internal sound sources	None
Office type	Open workfloor	Cell office	Flexible office	None
View	Only urban environment	Combination of urban and green elements	Fully green environment	None
Provisions	Reception + Standard (company) restaurant	Reception + Healthy (company) restaurant	Reception + Healthy (company) restaurant + Fitness + (Retail)services	None

[Description of aspects]

ASPECT	Description
Indoor air quality	The way the air in the office spaces is ventilated. A distinction is made in implementation of air treatment (moisture and CO_2 concentration) and air filtering (extracting fine dust, odors, bacteria).
Thermal comfort	The way the temperature in the office spaces is controlled. A distinction is made in system type, comfort fluctuation and adjustability.
Exposure to light	The amount and quality of light at a workstation in the office. This influenced by window size, sun blinds and light fittings.
Noise & acoustics	The reduction of noise in the office through acoustic measures. This can be achieved by blocking noise from outside the office (traffic, building installations etc.) as well as absorbing noise within the office space (footsteps, conversations etc.).
Office type	The layout/floor plan of the office spaces. An open workfloor has no walls; a cell office consists of enclosed spaces for max. 3 persons; a flexible office consists of different types of workplaces without a fixed workstation per employee.
View	The degree of green elements in the view from the office through windows. Green elements can be applied in public spaces (trees, grass etc.) as well as on the facades and roofs of the office building itself.
Provisions	The presence of facilities in the office building. In addition to a reception and a canteen, these can also be facilities that encourage healthy nutrition and physical activity, stimulate social integration or reduce stress.

Q13 – Q21: [9 choice sets according to design]

Which imaginary office workplace has your preference?
If you do not prefer both choices, choose 'No preference'

If you want to read more information about an aspect, move your mouse over that aspect.

Appendix C. SBI classification by 1st digit (CBS, 2019)

Agriculture, forestry and fishing
Mining and quarrying
Manufacturing
Electricity, gas, steam and air conditioning supply
Water supply; sewerage, waste management and remediation activities
Construction
Wholesale and retail trade; repair of motor vehicles and motorcycles
Transportation and storage
Accommodation and food service activities
Information and communication
Financial institutions
Renting, buying and selling of real estate
Consultancy, research and other specialized business services
Renting and leasing of tangible goods and other business support services
Public administration, public services and compulsory social security
Education
Human health and social work activities
Culture, sports and recreation
Other service activities
Activities of households as employers; undifferentiated goods- and service- producing activities of households for own use
Extraterritorial organizations and bodies

Appendix D. Health promotion/wellness program components

Characteristics Of Worksite Wellness Programs (Baicker, Cutler, & Song, 2010)	Included in questionnaire
Health risk assessment	Health risk assessment (e.g. biometric screening)
Self-help education materials	Self-help education materials
Individual counseling	Individual counseling/coaching (physical/mental)
Classes, seminars, group activities	Classes, seminars, group activities
Added incentives for participation	Added incentives for participation (e.g. sport subscription, bike purchase compensation)

Appendix E. Motivations not to have policies and strategies regarding workers' health

Reasons for having no plans for a wellness strategy (Buck Consultants/Xerox Corporation, 2014)	Included in questionnaire
Lack of budget	Lack of budget
Do not know how to organize or get started	Do not know how to organize or get started
Insufficient management support	Insufficient management support
Lack of business case to support implementation of wellness strategy	Lack of business case to support implementation of health strategy
Insufficient internal ownership	Insufficient demand of employees
Belief that managing employee health is not the role of the organization	Belief that managing employee health is not the role of the organization
Company culture is incompatible with wellness messages	Does not meet the image of the organization

Appendix F. General email to tenants with invitation for participating the survey.

Dear tenant of [building name],

For our research about the demand for healthy office environments, we would like to ask you to participate in a survey regarding the office space that your organization is renting in [building name].

The survey is part of the master thesis of Wietse Buskermolen, who is conducting his graduation research at the Eindhoven University of Technology (TU/e) in collaboration with CBRE Global Investors. The questionnaire aims to identify lessee preferences of healthy office workplaces.

The questionnaire consists of 9 choice sets in which your assessment of characteristics of office workplaces is tested as well as some personal and company-specific characteristics. Filling in the questionnaire takes 5 - 10 minutes. Your answers will be treated confidentially and cannot be traced back to the identity of an individual person or company. The research results can be shared with you on request.

You can participate in the research via this link: https://vragen9.ddss.nl/q/HealthyWorkplace

If you have any questions or comments regarding the research or this questionnaire, please contact us at w.buskermolen@student.tue.nl or +31 622013254.

Sincerely,
Wietse Buskermolen
Graduate Intern CBRE Global Investors

Appendix G. Effect coding scheme.

Attribute	Model labels		Attribute level	Coding	
Constant	CON	(β0)	No Preference	0	0
Indoor Air Quality	AIAQ	(β1)	Ventilation indoor-outdoor air	1	0
	BIAQ	(β2)	Ventilation with air treatment	0	1
		−(β1+β2)	Ventilation with air treatment and air filtering	-1	-1
Thermal comfort	ATC	(β1)	Radiators + Airco-units (much comfort fluctuation)	1	0
	BTC	(β2)	Controlled system with comfort fluctuation	0	1
		−(β1+β2)	Balanced system with minor comfort fluctuation + Adjustable per space	-1	-1
Exposure to light	AETL	(β1)	Standard window size + Standard light fittings	1	0
	BETL	(β2)	Standard window size with sun blinds + Light fittings with daylight correction	0	1
		−(β1+β2)	Large window size with adjustable sun blinds + Adjustable light fittings	-1	-1
Noise & Acoustics	ANA	(β1)	No acoustic measurements	1	0
	BNA	(β2)	Acoustic insulation external sound sources	0	1
		−(β1+β2)	Acoustic insulation external & absorption internal sound sources	-1	-1
Office type	AOT	(β1)	Open workfloor	1	0
	BOT	(β2)	Cell office	0	1
		−(β1+β2)	Flexible office	-1	-1
View	AVIEW	(β1)	Only urban environment	1	0
	BVIEW	(β2)	Combination of urban and green elements	0	1
		−(β1+β2)	Fully green environment	-1	-1
Provisions	APROV	(β1)	Reception + Standard (company) restaurant	1	0
	BPROV	(β2)	Reception + Healthy (company) restaurant	0	1
		−(β1+β2)	Reception + Healthy (company) restaurant + Fitness + (Retail)services	-1	-1
Rental price	ARP	(β1)	Current rent	1	0
	BRP	(β2)	Current rent + 5%	0	1
		−(β1+β2)	Current rent + 10%	-1	-1

Appendix H. Overview of variable names and variable codes.

Variable Name	Variable Code
Gender	Gender
Age	Age
Decision making of real estate accommodation	InfuenceDM
Office Building	Building
Business center concept (Type of lease)	Lease
FTE Office Building	FTE
FTE related to total organization	FTE_Org
Primary Activity	Sector
Maturity	Maturity
Organizational focus	HStrategy
Implementation of employee health strategy and/or policy	Focus
Promoting marketing and sales	Promoting_M&S
Stimulating Innovation	Innovation
Increasing employee satisfaction	EmployeeSatisfaction
Increasing productivity	Productivity
Flexibility of rental agreement	Flexibility
Cost efficiency	CostEfficiency
Sustainability (socially responsible)	Sustainability

Appendix I. Overview of derived variables from original variables.

Original Variable Code	Original Values	Derived Variable Code	Derived Values
[Building]	WTC Amsterdam Nieuw Amsterdam Gebouw UP office building NoMa House Herengracht WTC Schiphol Airport WTC Utrecht Delftse Poort	[BuildingCity]	Amsterdam Schiphol Utrecht Rotterdam
	WTC Amsterdam Nieuw Amsterdam Gebouw UP office building NoMa House Herengracht WTC Schiphol Airport WTC Utrecht Delftse Poort	[BuildingTenants]	< 100 tenants > 100 tenants
	WTC Amsterdam Nieuw Amsterdam Gebouw UP office building NoMa House Herengracht WTC Schiphol Airport WTC Utrecht Delftse Poort	[BuildingSize]	< 20,000 sqm 20,000-50,000 sqm >50,000 sqm
[Lease]	Regular business center (Direct lease) Serviced office (Indirect lease) Other	[Lease_Dir_Ind]	Regular business center (Direct lease) Serviced office (Indirect lease)
[FTE]	0 - 10 FTE 10 - 20 FTE 20 - 50 FTE 50 - 100 FTE > 100 FTE	[FTE_S_M]	< 20 FTE >20 FTE
[Sector]	Financial institutions Consultancy, research, legal and other specialized business services Other service activities Information and communication Transportation and storage Education Utility services Wholesale and retail trade Mining and quarrying Manufacturing Renting, buying and selling of real estate Renting and leasing of tangible goods and other business support services Agriculture, forestry and fishing Human health and social work activities Culture, sports and recreation Extraterritorial organizations and bodies	[Sector_Less]	Financial services Commercial services Trade and Industry Other
[Maturity]	Starting Growing Mature	[Mature_Y_N]	Starting/growing Mature
[HStrategy]	Yes No Unknown	[HStrategy_Y_N]	Yes No

Appendix J. Statistics of χ2-tests between organizational characteristics

Variable	N	χ²	df	Sig.	Significance level 1%	5%	10%
BuildingTenants * BuildingSize	84	72,800ᵃ	2	0,000	Yes	Yes	Yes
BuildingTenants * Lease	84	10,166ᵃ	2	0,006	Yes	Yes	Yes
BuildingTenants * Lease_Dir_Ind	84	7,586ᵃ	1	0,006	Yes	Yes	Yes
BuildingTenants * Sector_Less	84	9,684ᵃ	3	0,021	No	Yes	Yes
BuildingSize * HStrategy_Y_N	70	6,533ᵃ	2	0,038	No	Yes	Yes
Lease * FTE_S_M	84	15,970ᵃ	2	0,000	Yes	Yes	Yes
Lease_Dir_Ind * FTE_S_M	73	14,209ᵃ	1	0,000	Yes	Yes	Yes
Lease_Dir_Ind * FTE_Org	73	5,739ᵃ	2	0,057	No	No	Yes
FTE_S_M * FTE_Org	84	6,925ᵃ	2	0,031	No	Yes	Yes
FTE_S_M * Maturity	84	6,186ᵃ	2	0,045	No	Yes	Yes
FTE_S_M * Mature_Y_N	84	3,054ᵃ	1	0,081	No	No	Yes
FTE_S_M * Strategy	84	7,115ᵃ	2	0,029	No	Yes	Yes
FTE_S_M * HStrategy_Y_N	70	4,161ᵃ	1	0,041	No	Yes	Yes
FTE_Org * Mature_Y_N	84	5,131ᵃ	2	0,077	No	No	Yes
FTE_Org * HStrategy_Y_N	70	5,757ᵃ	2	0,056	No	No	Yes
Maturity * HStrategy_Y_N	84	18,124ᵃ	2	0,000	Yes	Yes	Yes
Mature_Y_N * Strategy	84	15,847ᵃ	2	0,000	Yes	Yes	Yes
Mature_Y_N * HStrategy_Y_N	70	15,240ᵃ	1	0,000	Yes	Yes	Yes
BuildingTenants * Innovation	84	3,977ᵃ	1	0,046	No	Yes	Yes
BuildingTenants * EmployeeSatisfaction	84	3,055ᵃ	1	0,081	No	No	Yes
BuildingTenants * Productivity	84	3,111ᵃ	1	0,078	No	No	Yes
BuildingTenants * Flexibility	70	6,222ᵃ	1	0,013	No	Yes	Yes
BuildingSize * Productivity	84	5,812ᵃ	2	0,055	No	No	Yes
Lease * EmployeeSatisfaction	84	6,360ᵃ	2	0,042	No	Yes	Yes
Lease_Dir_Ind * EmployeeSatisfaction	73	3,202ᵃ	1	0,074	No	No	Yes
FTE_S_M * EmployeeSatisfaction	84	2,888ᵃ	1	0,089	No	No	Yes
FTE_S_M * Productivity	84	7,143ᵃ	1	0,008	Yes	Yes	Yes
FTE_Org * Innovation	84	7,429ᵃ	2	0,024	No	Yes	Yes
FTE_Org * EmployeeSatisfaction	84	5,403ᵃ	2	0,067	No	No	Yes
FTE_Org * Sustainability	84	7,879ᵃ	2	0,019	No	Yes	Yes
Sector_Less * Promoting_M&S	84	11,211ᵃ	3	0,011	No	Yes	Yes
Maturity * CostEfficiency	84	5,435ᵃ	2	0,066	No	No	Yes
Mature_Y_N * CostEfficiency	84	5,012ᵃ	1	0,025	No	Yes	Yes
HStrategy * CostEfficiency	70	3,960ᵃ	1	0,047	No	Yes	Yes

a: meets the precondition that no more than 20% of the expected count is less than 5 and the minimum expected count is at least 1

Appendix K. Attributes levels of office buildings that are included in the sample.

ATTRIBUTE	WTC Amsterdam	Nieuw Amsterdam Gebouw	UP office building	NoMa House	Herengracht	WTC Schiphol Airport	WTC Utrecht	Delftse Poort
Indoor Air Quality	Ventilation with air treatment and air filtering	Ventilation with air treatment and air filtering	Ventilation with air treatment and air filtering	Ventilation with air treatment and air filtering	Ventilation indoor-outdoor air	Ventilation with air treatment and air filtering	Ventilation with air treatment and air filtering	Ventilation with air treatment and air filtering
Thermal comfort	Balanced system with minor comfort fluctuation + Adjustable per space	Balanced system with minor comfort fluctuation + Adjustable per space	Balanced system with minor comfort fluctuation + Adjustable per space	Balanced system with minor comfort fluctuation + Adjustable per space	Radiators + Airco-units (much comfort fluctuation)	Balanced system with minor comfort fluctuation + Adjustable per space	Balanced system with minor comfort fluctuation + Adjustable per space	Balanced system with minor comfort fluctuation + Adjustable per space
Exposure to light	Standard window size with sun blinds + Light fittings with daylight correction	Standard window size with sun blinds + Light fittings with daylight correction	Standard window size with sun blinds + Light fittings with daylight correction	Standard window size with sun blinds + Light fittings with daylight correction	Standard window size + Standard light fittings	Standard window size with sun blinds + Light fittings with daylight correction	Standard window size with sun blinds + Light fittings with daylight correction	Standard window size with sun blinds + Light fittings with daylight correction
Noise & Acoustics	Acoustic insulation external sound sources	Acoustic insulation external sound sources	Acoustic insulation external sound sources	Acoustic insulation external sound sources	Acoustic insulation external sound sources	Acoustic insulation external & absorption internal sound sources	Acoustic insulation external sound sources	Acoustic insulation external sound sources
Office type	Cell office	Flexible office	Flexible office	Flexible office	Flexible office	Flexible office	Flexible office	Flexible office
View	Only urban environment	Only urban environment	Combination of urban and green elements	Combination of urban and green elements	Only urban environment	Only urban environment	Only urban environment	Only urban environment
Provisions	Reception + Healthy (company) restaurant + Fitness + (Retail)services	Reception + Healthy (company) restaurant + Fitness + (Retail)services	Reception + Healthy (company) restaurant + Fitness + (Retail)services	Reception + Healthy (company) restaurant + Fitness + (Retail)services	Reception + Healthy (company) restaurant	Reception + Healthy (company) restaurant + Fitness + (Retail)services	Reception + Healthy (company) restaurant + Fitness + (Retail)services	Reception + Healthy (company) restaurant + Fitness + (Retail)services

Appendix L. Nlogit command Multinomial Logit model & Latent Class model.

```
NLOGIT
;Choices=AltA,AltB,NoPr
;pds=9
;Lhs=choice
;Rhs=Con,Aiaq,Biaq,Atc,Btc,Aetl,Betl,Ana,Bna,
Aot,Bot,Aview,Bview,Aprov,Bprov,Arp,Brp
;parameters
;lcm
;pts=2$
```

Appendix M. Nlogit output Multinomial Logit model (Choices=756, N=84).

```
---------------------------------------------------------------------------
Discrete choice (multinomial logit) model
Dependent variable                 Choice
Log likelihood function      -707.84199
Estimation based on N =     756, K =   17
Inf.Cr.AIC  =   1449.7 AIC/N =     1.918
Model estimated: Jul 09, 2019, 19:16:44
R2=1-LogL/LogL* Log-L fncn R-sqrd R2Adj
Constants only   -796.6786  .1115 .0905
Response data are given as ind. choices
Number of obs.=   756, skipped    0 obs
```

CHOICE	Coefficient	Standard Error	z	Prob. |z|>Z*	95% Confidence Interval	
CON|1|	.66333***	.09392	7.06	.0000	.47926	.84741
AIAQ|1|	-.04936	.08038	-.61	.5392	-.20689	.10818
BIAQ|1|	-.16709**	.08109	-2.06	.0393	-.32602	-.00817
ATC|1|	-.36891***	.08349	-4.42	.0000	-.53254	-.20528
BTC|1|	-.03983	.07956	-.50	.6166	-.19578	.11611
AETL|1|	-.07840	.08176	-.96	.3376	-.23864	.08185
BETL|1|	-.03941	.08049	-.49	.6244	-.19717	.11835
ANA|1|	-.35791***	.08351	-4.29	.0000	-.52158	-.19424
BNA|1|	.05822	.08145	.71	.4748	-.10143	.21786
AOT|1|	-.22712***	.08513	-2.67	.0076	-.39398	-.06026
BOT|1|	.16562**	.08125	2.04	.0415	.00638	.32486
AVIEW|1|	-.18469**	.08140	-2.27	.0233	-.34424	-.02515
BVIEW|1|	.04008	.07919	.51	.6128	-.11513	.19530
APROV|1|	-.33825***	.08082	-4.19	.0000	-.49665	-.17985
BPROV|1|	.04992	.08115	.62	.5384	-.10913	.20897
ARP|1|	.51619***	.08165	6.32	.0000	.35617	.67621
BRP|1|	.17807**	.08270	2.15	.0313	.01599	.34015

```
Note: ***, **, * ==>  Significance at 1%, 5%, 10% level.
---------------------------------------------------------------------------
```

Appendix N. WTP-values regarding the Multinomial Logit model (Choices=756, N=84).

Model labels		Coefficient (β)	Sig.	Corrected β	Utility + 1 AL	WTP + 1 AL	Utility + 2 AL	WTP + 2 AL
CON	(β0)	1,267	***	1,267				
AIAQ	(β1)	-0,044		0,000				
BIAQ	(β2)	-0,177	**	-0,177	-0,177	-1,48%		
	−(β1+β2)	0,221		0,177	0,354	2,95%	0,177	1,48%
ATC	(β1)	-0,374	***	-0,374				
BTC	(β2)	-0,038		0,000	0,374	3,12%		
	−(β1+β2)	-0,081		0,374	0,374	3,12%	0,749	6,25%
AETL	(β1)	-0,078		0,000				
BETL	(β2)	-0,039		0,000				
	−(β1+β2)	-0,040		0,000				
ANA	(β1)	-0,354	***	-0,354				
BNA	(β2)	0,048		0,000	0,354	2,95%		
	−(β1+β2)	0,305		0,354	0,354	2,95%	0,708	5,90%
AOT	(β1)	-0,230	***	-0,230				
BOT	(β2)	0,173	**	0,173	0,403	3,36%		
	−(β1+β2)	0,057		0,057	-0,116	-0,97%	0,287	2,39%
AVIEW	(β1)	-0,188	**	-0,188				
BVIEW	(β2)	0,035		0,000	0,188	1,57%		
	−(β1+β2)	0,154		0,188	0,188	1,57%	0,376	3,14%
APROV	(β1)	-0,336	***	-0,336				
BPROV	(β2)	0,047		0,000	0,336	2,80%		
	−(β1+β2)	0,289		0,336	0,336	2,80%	0,672	5,60%
RPWTP	(β)	-0,120	***	-0,120				

***, **, * → Significance at 1%, 5%, 10% level

Appendix O. Nlogit output Latent Class model (Choices=756, N=84).

```
------------------------------------------------------------------------------
Latent Class Logit Model
Dependent variable                  CHOICE
Log likelihood function      -604.13957
Restricted log likelihood    -830.55089
Chi squared [  35 d.f.]       452.82264
Significance level                .00000
McFadden Pseudo R-squared        .2726038
Estimation based on N =      756, K =   35
Inf.Cr.AIC  =    1278.3 AIC/N =     1.691
Model estimated: Jul 09, 2019, 19:16:45
R2=1-LogL/LogL* Log-L fncn R-sqrd R2Adj
No coefficients  -830.5509  .2726 .2554
Constants only   -796.6786  .2417 .2237
At start values  -707.8406  .1465 .1263
Response data are given as ind. choices
Number of latent classes =          2
Average Class Probabilities
      .734   .266
LCM model with panel has      84 groups
Fixed number of obsrvs./group=        9
Number of obs.=   756, skipped    0 obs
```

```
--------+---------------------------------------------------------------------
        |                  Standard            Prob.      95% Confidence
 CHOICE| Coefficient       Error       z    |z|>Z*         Interval
--------+---------------------------------------------------------------------
        |Utility parameters in latent class -->> 1
  CON|1|    2.13833***      .21745    9.83  .0000    1.71214   2.56453
 AIAQ|1|    -.14492         .09696   -1.49  .1350    -.33496    .04512
 BIAQ|1|    -.14176         .09601   -1.48  .1398    -.32994    .04643
  ATC|1|    -.38104***      .09830   -3.88  .0001    -.57370   -.18838
  BTC|1|    -.06511         .09210    -.71  .4796    -.24563    .11541
 AETL|1|    -.00175         .09653    -.02  .9856    -.19094    .18744
 BETL|1|    -.01665         .09647    -.17  .8630    -.20573    .17243
  ANA|1|    -.47351***      .09782   -4.84  .0000    -.66523   -.28180
  BNA|1|    -.05033         .09547    -.53  .5981    -.23745    .13679
  AOT|1|    -.20346**       .09903   -2.05  .0399    -.39756   -.00935
  BOT|1|     .14017         .09556    1.47  .1424    -.04711    .32746
AVIEW|1|    -.10257         .09804   -1.05  .2954    -.29472    .08958
BVIEW|1|     .00392         .09391     .04  .9667    -.18014    .18797
APROV|1|    -.36945***      .09499   -3.89  .0001    -.55562   -.18327
BPROV|1|     .08060         .09556     .84  .3990    -.10669    .26790
  ARP|1|     .38579***      .11168    3.45  .0006     .16690    .60468
  BRP|1|     .23904**       .09957    2.40  .0164     .04388    .43420
```

[Table continues on following page]

```
          |Utility parameters in latent class -->> 2
   CON|2|    -1.67096***      .29006    -5.76  .0000    -2.23947  -1.10244
  AIAQ|2|     -.05818         .25288     -.23  .8180     -.55382   .43746
  BIAQ|2|     -.13577         .25394     -.53  .5929     -.63347   .36194
   ATC|2|     -.14458         .25174     -.57  .5658     -.63799   .34883
   BTC|2|      .04858         .26877      .18  .8566     -.47819   .57536
  AETL|2|     -.46954*        .27953    -1.68  .0930    -1.01741   .07834
  BETL|2|      .07601         .25454      .30  .7652     -.42289   .57491
   ANA|2|     -.15306         .25356     -.60  .5461     -.65003   .34390
   BNA|2|      .37386*        .21939     1.70  .0884     -.05614   .80386
   AOT|2|     -.55598*        .29233    -1.90  .0572    -1.12893   .01696
   BOT|2|      .26088         .27793      .94  .3479     -.28386   .80562
 AVIEW|2|     -.63768**       .25850    -2.47  .0136    -1.14433  -.13104
 BVIEW|2|      .26299         .23833     1.10  .2698     -.20412   .73010
 APROV|2|     -.38729         .29621    -1.31  .1911     -.96786   .19328
 BPROV|2|      .06449         .25872      .25  .8032     -.44260   .57158
   ARP|2|     1.51126***      .27745     5.45  .0000      .96748  2.05505
   BRP|2|      .40446         .27625     1.46  .1432     -.13699   .94591
          |Estimated latent class probabilities
 PrbCls1|      .73368***      .05429    13.51  .0000      .62727   .84009
 PrbCls2|      .26632***      .05429     4.91  .0000      .15991   .37273
--------+----------------------------------------------------------------
Note: ***, **, * ==>  Significance at 1%, 5%, 10% level.
--------------------------------------------------------------------------
```

Appendix P. Statistics of χ2-tests between demographics, organizational characteristics and class.

| | | | | | Significance level | | |
Variable	N	χ²	df	Sig.	1%	5%	10%
Building * Class	84						
BuildingCity * Class	84						
BuildingTenants * Class	84	2,367ᵃ	1	0,124	No	No	No
BuildingSize * Class	**84**	**8,679ᵃ**	**2**	**0,013**	No	Yes	Yes
Lease * Class	84	,520ᵃ	2	0,771	No	No	No
Lease_Dir_Ind * Class	73	,510ᵃ	1	0,475	No	No	No
FTE * Class	84						
FTE_S_M * Class	**84**	**4,734ᵃ**	**1**	**0,030**	No	Yes	Yes
FTE_Org * Class	84	,857ᵃ	2	0,652	No	No	No
Focus * Class	84	2,091ᵃ	3	0,554	No	No	No
Promoting_M&S * Class	84	,130ᵃ	1	0,719	No	No	No
Innovation * Class	84	2,238ᵃ	1	0,135	No	No	No
EmployeeSatisfaction * Class	84	1,328ᵃ	1	0,249	No	No	No
Productivity * Class	84	,016ᵃ	1	0,899	No	No	No
Flexibility * Class	84	,201ᵃ	1	0,654	No	No	No
CostEfficiency * Class	84	,714ᵃ	1	0,398	No	No	No
Sustainability * Class	84	,473ᵃ	1	0,491	No	No	No
Sector * Class	84						
Sector_Less * Class	**84**	**11,297ᵃ**	**3**	**0,010**	No	Yes	Yes
Maturity * Class	84	,447ᵃ	2	0,800	No	No	No
Mature_Y_N * Class	84	,168ᵃ	1	0,682	No	No	No
HStrategy * Class	84	,494ᵃ	2	0,781	No	No	No
HStrategy_Y_N * Class	70	,483ᵃ	1	0,487	No	No	No

a: meets the precondition that no more than 20% of the expected count is less than 5 and the minimum expected count is at least 1

Appendix Q. Cross tables of significant χ2-tests between organizational characteristics and class

Latent Class - Size of Office Building

Building Size	LC1	LC2
< 20,000 sqm	6	15
20,000 - 50,000 sqm	11	7
>50,000 sqm	30	15

Latent Class - FTE

FTE Office Building	LC1	LC2
< 20 FTE	36	20
> 20 FTE	11	17

Latent Class - Primary Activity

Sector	LC1	LC2
Financial services	17	8
Commercial services	14	7
Trade and Industry	8	3
Other	8	19