Does the office design effect the occupant's productivity?

A Master's Thesis submitted for the degree of
"Master of Business Administration"

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Vienna, 10.04.2019

Affidavit

I, **CHRISTOPHER PREINING**, hereby declare

1. that I am the sole author of the present Master's Thesis, "DOES THE OFFICE DESIGN EFFECT THE OCCUPANT'S PRODUCTIVITY?", 95 pages, bound, and that I have not used any source or tool other than those referenced or any other illicit aid or tool, and
2. that I have not prior to this date submitted the topic of this Master's Thesis or parts of it in any form for assessment as an examination paper, either in Austria or abroad.

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Acknowledgement

Abstract

In this master thesis, describes the impact of the office environment on the employee's satisfaction and productivity of an Austrian public company. To collect appropriate data several experts from the company were interviewed, which work in different office types. The data extracted from the survey was evaluated with qualitative content analysis.

The results of the study were linked and compared to existing literature. The aim was to find similarities and differences between the test persons and the literature. The survey shows that the majority of the results correspond with different researches. It is proven, that the office environment impacts the occupant's productivity. The case study demonstrates, that a well-designed office environment increases the user`s productivity. The most important factors are: physical factors such as air quality, temperature, acoustics, lighting, and social factors. The company under consideration employs more than 3000 employees. Therefore, Social interaction is a very important factor. Working in teams and alone is a challenging task, which can be improved by the proper office design. The statements of the employees underline the literature research.

According to the literature the company under investigation, is owned by public. Such companies have a stricter structure than private companies. The job satisfaction and productivity of employees depends to a large extent on physical and social factors. Wishes for improvements were implemented in the paper to increase productivity of the workers in the future.

The aim is to make it understandable, that there are two sides, one is the user and one is the provider side. Both should have a greater outcome at the end. It is indispensable to make workers feel comfortable within the company to ensure a long-term success. To reach a gain in productivity the employee's satisfaction should be considered.

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1. Introduction

The human well-being is influenced by many different factors. Related to office buildings, the interior of the facility has a great influence on the human being. The environmental psychology deals with the impact of the physical environment on the occupants. Laws and standards reflect the current 'state of the art'. The most important parameters show the EN 15251 (cf. A.Redlein, C.Hax-Noske, 2016, pp. 38).

The efficiency of companies gets nowadays a big attention, and the firms start to pay more consideration on the work environment (cf. Fischer 2005, pp. 5). Work is changing and is based on different kind of skills, that the employee should bring along nowadays. These abilities depend on social-, knowledge- and team- based skills. However, the time pressure in a fast-changing environment has a big impact on businesses (cf. J. Heerwagen et al. 2010, pp. 1).

In the end of the 90s Horgen at al. created a new model of workplace design, which says that new ways of working needs to be designed in a new way. Researcher explored a never-ending process, which contains the four most important management departments in a company. Financial management, organizational design, information technology, and facilities management need to work together to get the most efficient outcome. Designing a place for employees to work productive is the aim to achieve. There are two different approaches. On the one hand, the old school method, which says that each company creates its own way (cf. Monge 1995, pp. 323). On the other hand, Klaus, Krippendorff (2006) displays, that changes can turn into challenges, which may lead to improvements and opportunities for the future. The companies should always keep in mind that the employees are the heart of every firm. Therefore, it is important to invest in the quality of a comfortable office environment which leads to well-being and efficiency (cf. Roelofsen, 2002, pp.1).

1.1. Initial situation

In nowadays' fast changing environment experts suggests, to build offices as flexible as possible to adapt to new circumstances. The company under investigation which will be described in Chapter 1.2. is expanding by employing more office workforce. The large public enterprise is facing the issue that too less space is available and provided at the moment. To solve this problem there are two opinions: Option one is to build a new office building where there will be sufficient space for the new employees. Option two, to break the strict boundaries and create a new multi space environment. The concerns of the managers are, that people who worked for a long time in cell offices won't work as efficient as now.

To ensure a long-term improvement of the firm a survey was done by the author to understand how the employees feel in the present office environment. The study should help the management to make the right decision. On one hand building a new office facility is a big investment and on the other hand the owner of the company (the Austrian state) wants to improve the employee`s satisfaction.

1.1.1. Limitations

Public companies are different than private companies. Strict rules and regulations, boundaries and slower adaptions are typical for them. The lack of literature on how public companies should organize their workplaces to ensure long living office types, literature based on private companies was chosen.

1.2. Company under investigation

The enterprise is a "Linz holding" company which is owed by the city of Linz, in Upper Austria. It offers energy supply, municipal services and public transport in Linz. At the moment the company employs around 3100 people. The company generated a turnover of around 697 million euros in 2015.

The mostly used office type is the traditional cell office, but also different office types are provided in the building. The following pictures show the office building which has too less capacity at the moment.

Figure 1 Company´s office building (own figure)
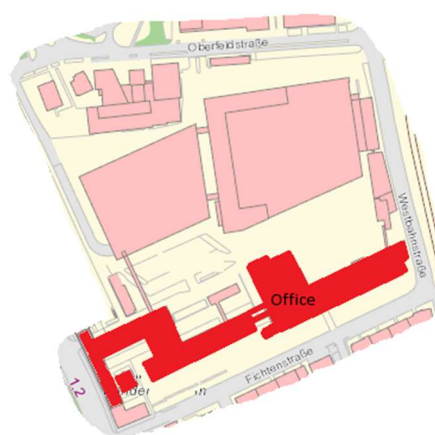
Figure 2 Office building http://doris.ooe.gv.at (04.04.2019)

1.3. Research question

This paper analyzes the impact of an office design and its environment on the occupant's satisfaction and productivity. Different office types have a different influence on the users. For example, open offices increase the communication, but at the same time it decreases the privacy. Not only the typology plays a big role in office building, also the physical values. Noise destructions, light, temperature and many other factors influence occupant's wellbeing, satisfaction and performance. The question is formulated in such a way, that it can be answered within the framework of the planned study and the available resources:

Does the office design effect the occupant's productivity?

The aim of the paper is to provide appropriate data on how the company should design the office environment in the future to ensure an overall improvement. The employee's satisfaction and productivity should increase. Another target is to find out how satisfied the employees are with the current office environment.
In addition to the research questions, the following question will be answered in the context of this work:

How do the employees rate the working environment at the moment?

In order to answer the research questions, the above-mentioned topics will be analyzed by literature research and discussed with the results of the survey.

1.4. Procedure

In chapter 1 the reader will get a closer look into the theoretical background. Specialized literature from various field was used.

Chapter 2 deals with the various types of offices. Foregrounded is the office by itself. The advantages and disadvantages of the office typologies and their characteristics are described briefly.

Chapter 3 describes the legal regulations in Austria, that are relevant for office rooms. Therefore, different laws describe the requirements in office buildings.

In chapter 4 the concepts job satisfaction and performance are examined.

Chapter 5 describes the physical values such as: Indoor air quality, thermal comfort, lighting, acoustics, layout, the look, and the location

New Ways of Working and its impact will be presented in chapter 6.

Chapter 7 shows the empirical research. The subchapters contain how the study was done.

The results of the survey will be summarized in 8 part of the of the work. The next chapter deals with the improvements of the office building.

In chapter 10 the influence of the workspace on the productivity is evaluated based on empirical research which is done within the company. The results are compared with the findings of the researched literature.

In the last chapter the results of the study will be summarized.

2. Typology of office space concepts

In the theoretical part of the present work, the different office concepts will be presented. In the following subchapters contain the development of office typologies. According to the literature the nowadays mostly used office types will be examined in detail.

2.1. Historical development

In the development of the history of employment, the importance of the office as a workplace has increased and constantly changed. Till the 60s companies paid little attention on the workplace design. The trend was to design oversized open office spaces and rows of cellular office rooms. Communication and openness to the employees were not payed as much attention as nowadays. (cf. Nootz & Zinser, 2008, pp. 185). Later, the company's corporate design got more attention. The aim was to improve the office design in a way to increase personality development, harmlessness and feasibility (cf. Hacker & Richter, 1980). According to Windlinger et al, (2014) numerous studies have proven, that office spaces and its designs have a major impact on health and well-being.

The support of performance, productivity, innovation, communication and satisfaction play a central role in designing a proper fitting office environment. An increase in the retirement age means, that companies will have to employ their workers for a longer time. Disease prevention and health improvement will be more firmly anchored in corporate strategies in order to ensure, that the motivation and performance of the employees are can be preserved (cf. Richenhagen, 2009, pp. 73).

In nowadays modern offices, the office is a communicative place, that promotes community, corporate culture, encounters, exchanges and personal synergies. The progressive development of information technologies enables a continuous decoupling of office work from space and time. New office concepts for new requirements need to

be created. During the life cycle of a building, the office concept can change several times. By renovating a building, the company has the possibility to create more efficient and modern office spaces. (cf. Kleibrink 201, pp. 11)

According to Gottschalk (1994) there are five different office types. Each of them describes a new development period. All five basic forms of office concepts are still in use today. They can be structured in: Cell offices, open-plan offices, group offices, combined offices and non-territorial offices. By the change of time new types were created. For example: Multi-space-offices, shared offices and flexible offices. These names are new, but the office form is not something that is created nowadays. The new forms reflect on the 5 basic offices with and minor changes and adaptions (Ehlers et al. 2003, pp. 54)

In the following subchapters all five office types will be described in a brief way. The company under consideration provides many different office concepts but not all of them. For a better understanding all office types will be analyzed.

2.2. Cellular office

One of the most traditional forms of office types is the cellular office for single, double or multiple occupancy. This form`s advantage is that workers have the possibility for individual concentrated work and at the same time to work in groups where communication is essential. This type is typical for public companies and law firms. This kind of office typology is suitable for strictly hierarchical organizations, whose work processes are divided into many small work steps. In addition, the individual office offers the greatest possible individual freedom and allows to control temperature individually. The acoustic disturbance is minimally. All office rooms are located along the façade, which has the big advantage that natural light goes through the windows into the rooms. Corridors are arranged in the middle of the of the building. If the cellular office is used for more persons, the distortion can be higher. The ability to concentrate is considerably enhanced by telephone calls, customer conversations or

talks with the office partners. (cf. Kohlert, C. 2010) On the other Hand the cellular office can be used a as a single person office, which has the advantage to work individually in a quiet environment. The only disadvantage is, that the communication to colleagues and team members is missing. According to Knirsch (2002) the communication to other employees is mostly via email or telephone.
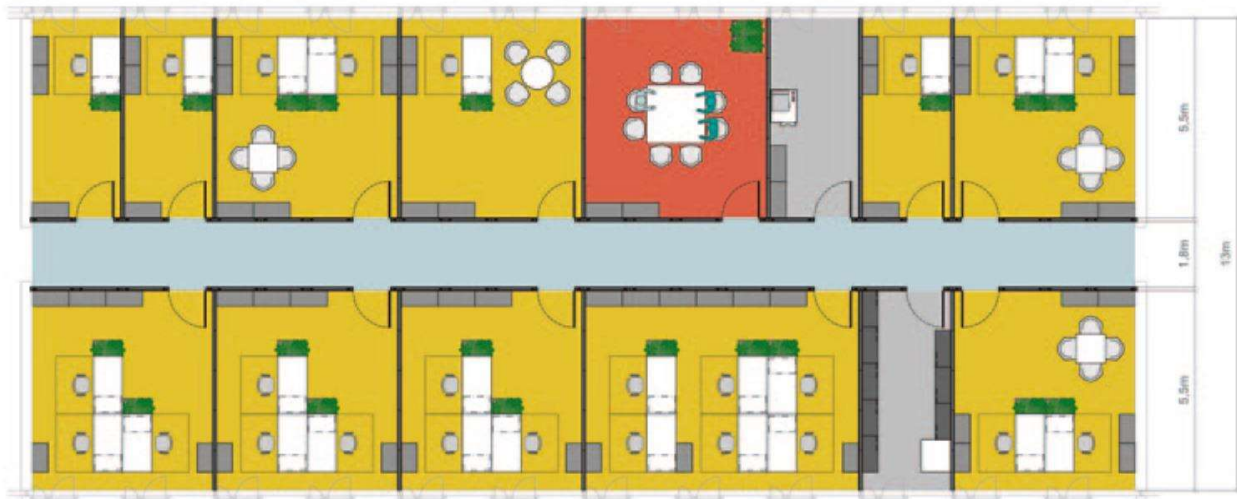
Figure 3Example of a cellular office (Klaffke 2016, p. 124)

2.3.   Combined Office

In the end of the 1970s, in Scandinavia, the combined office was developed. This form of office type combines the advantages of the cellular and the open office. The aim was to avoid the disadvantages of the two office types which are mentioned above. The working rooms are arranged along the façade of the building. The commercial used, and multifunctional area is situated in the middle of the floor plan. That communication areas are usually established out of big glass panels. As a result, the intelligent use of space of the commercial places and the high standard of workplaces, the company gains in flexibility and quality in communication. The offices are nine to twelve square meters and benefit from the natural lighting. Thanks to the glass walls, the office user is not isolated from the rest of the company, even when the door is

closed. In the communal and inner zones of the floor plan is a cross-working infrastructure, that can be used by all employees. Examples are: meeting areas and group working stations. There are no hierarchical differences in office rooms. This means, that all employees get treated equally. By separating workrooms and common areas, combined offices support processes that require a constant change between concentrated individual work and group work, that need a lot of communication with other colleagues. This design increases flexibility within the company and increases transparency in work processes. However, this office arrangement is not implemented often in recent years. The lower space efficiency and high building costs may be the reason.
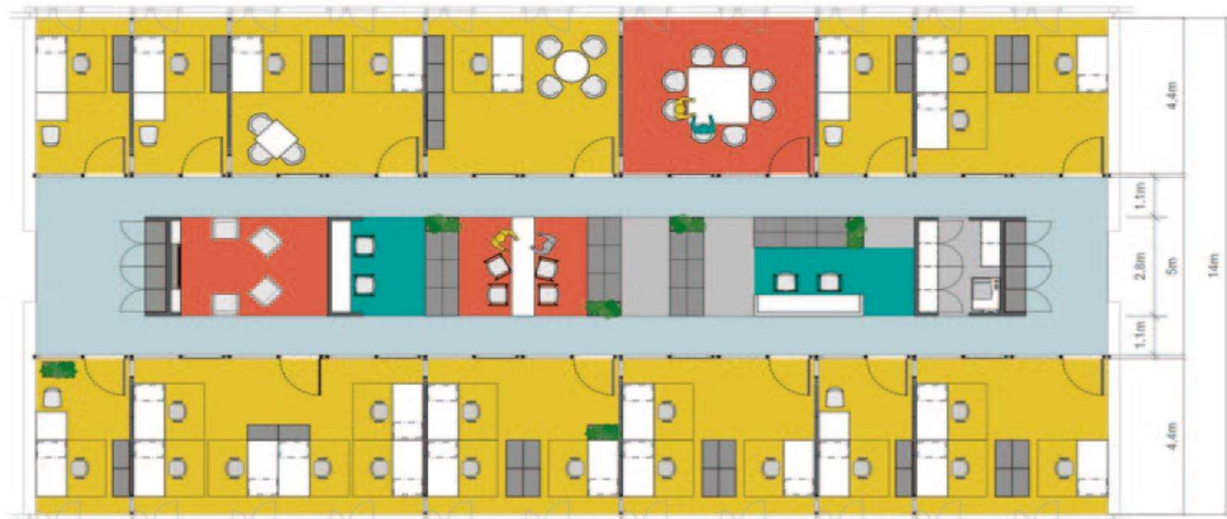
Figure 4 Example of a combined office (Klaffke, 2016, p.126)

2.4. Multi-Space-Office

The multi-space office divides the areas of the group and open-plan offices into zones for shared use and open workstations. In open offices the spaces were filled up with as many employees as possible. This is an older approach and did not improve the modern way of communication. The modern so-called multi-space offices improves

this new kind of working, by providing spatial areas, such as areas for relaxation and meeting with other employees. The essential building elements include rooms for team meetings, coffee bars, small lounges and think tanks. The decentralized service stations, which provide the necessary technology are accessible within short distances. Less employees need to walk through the whole building for printing. At the same time not, every workstation needs its own printer. The office is designed in a way to increase the quality of the office environment. For example, design elements are implemented within the inner office (cf. Kleibrink 2011, pp. 11). Thanks to this new development, the office creates now new ways of communication. New technologies for working in this new environment is essential

Figure 5 Example of a Multi-spac3-office (Rozzi, 2017, p.55)

2.5. Open-Plan-Office

The open-plan office was the former m office hall, which was used in North American factories. The idea of large rooms for people has its origin already in the 15th and 16th century, where writing rooms for twenty or more employees were arranged. (cf. Lorenz, 2002, pp. 59) However, the invention of big office halls with largely open structure was developed in the 1960s. At this time researcher called this typology: "working world of the future". The aim was to increase the communication within the company (cf. Knirsch, 2002, pp. 16). The structure, which was originally regarded as conducive to communication turned into the opposite. The oversized halls were places with acoustic problems and lack of privacy. Typical open-plan offices were built with a floor area of 600 to 1000 square meters and more. 25 to 100 and more employees worked in one hall. The average workplace requirement per employee was between twelve and 15 square meters (cf. Lorenz 2002, pp. 69). Today, open-plan offices are counterproductive for employees who must work individually. Furthermore, the climatic conditions are not individually adjustable and protection against acoustic, visual and olfactory interference is not possible (cf. Kleibrink 2011, pp. 12). If companies succeed in reducing disturbances to a minimum, the style of an open-plan-office may be attractive. Advantages can be, economic reasons, that comes along with an increase in flexibility and space efficiency (cf. Kleibrink 2011, pp. 16).
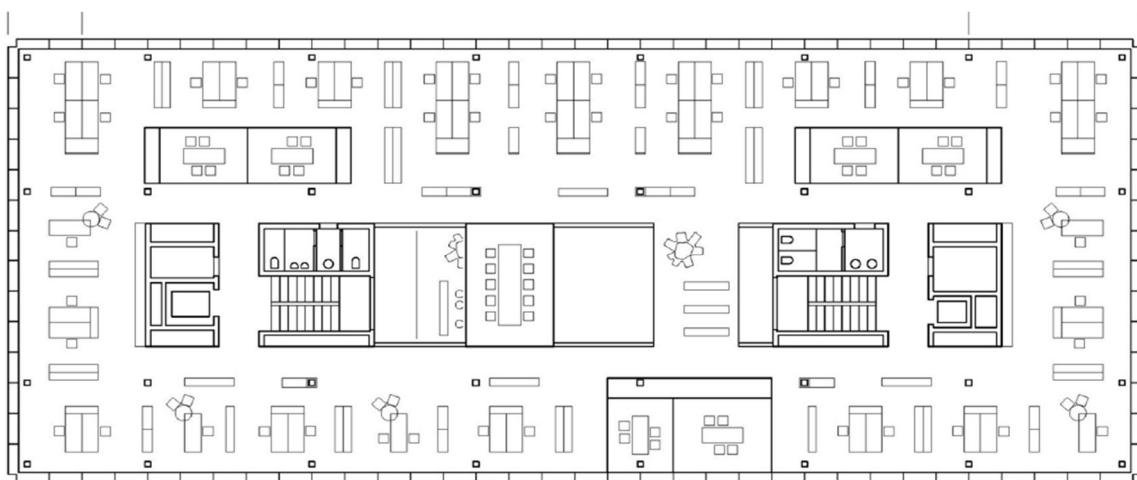
Figure 6 Example of an open-plan-office, http://www.unhingedprops.com/open-space-floor-plan-office/ (10.01.2019)

2.6.   Non-territorial-office

The non-territorial office is a new way of working type and was not mentioned in the classical office types above. Non-territorial office concepts can be implemented based on all previously described spatial concepts, since they are not dependent on a specific layout arrangement. The name already indicates, that not all workstations are used at the same time due to absence of employees. A unique characteristic is, that the workers have not their own desk, it is shared by several. The allocation of work places is cancelled. Companies provide their employees mobile storage facilities, which can transport the personal work equipment and documents to the current workplace (cf. Ehlers et al. 2003, pp. 134).

Figure 7 Example of a non-territorial-office https://www.smow.com/topics/office-furnishing/planning-furnishing-modern-offices.html (15.02.2019)

3. Legal legislations

In the following, it will be clarified which requirements the legislator places on companies. Just the most relevant laws for office spaces were chosen, because all laws which refer to office buildings would exceed the limits of this work.

3.1. Definition of a workplace

Workplace is the physical area in which workers are present during the work. (cf. Bundesrecht konsolidiert 1998). Workplaces must be set up and designed in such a way that workers can do their jobs as safe as possible (cf. Bundesrecht konsolidiert 1998). Special places for working have to be provided by the company. These are seats for working. If work seats cannot be set up or used at the workplace for operational reasons, there must be seats provided for temporary sitting. (cf Bundesrecht konsolidiert 1998) A work place, that contains a computer workstation hast to be at least 8m2. Every additional employee needs 5m2 extra space. Office rooms have a demand of 10% natural light, which is calculated by the floor square meter. There is also a legislation for the minimum height in an office room. This depends on the floor plan size. Only rooms with a height of at least 3.0 m may be used for working. If the dimensions of the room are between 100 and 500 square meters, the height has to be at least 2.80 m. For an area of more than 500m2 the height should be 2.5m or higher.

The room temperature depends on the physical stress. There are 3 different temperature zones:

First zone: In the zone with low physical stress level the temperate should be between 19 and 25 degrees Celsius.

Second zone: In this zone the physical work stress is normal, therefore the temperature can be a bit lower and should be between 18 and 24 degrees Celsius.

Third zone: High physical work stress needs at least 12 degrees Celsius.

There are certain rules to lower the temperature below the norm.

Workspaces shall be equipped with artificial lighting. Neutral colors have a positive influence on the working atmosphere. The illuminance in the entire room, measured 0.85 m above the floor, must be at least 100 lux. The lighting depends on the task to be executed. In exceptional cases, these requirements may be amended. (Bundesrecht konsolidiert 1998)

4. Satisfaction and productivity

In the following the definitions of satisfaction and productivity will be presented. Furthermore, the comfort model of Vischer (2008) gets a deeper few. Last but not least the productivity flow chart of Porter will be focused.

4.1. Work Satisfaction

Employees and managers are becoming an increasingly important element for companies. Analysis of the subjective work situation becomes a big factor (cf. Schulte and Wink 1985). Technological development does not require just motivation. Shorter and faster product cycles need innovative skills to manage upcoming changes. As a consequence, the contractual work obligation is set in the background. Foregrounded is the motivation and the job satisfaction. In the next few decades, companies will have to compete for qualified young skilled employees, due to the low birth rate of the baby-boomers. From the management's point of view, there are also other reasons for dealing with this issue. The "human goal of job satisfaction" has been promoted as an independent corporate goal (cf. Edwin A. Locke 1970, pp. 1). There are indications that certain forms of job satisfaction correspond to physical health. Dissatisfaction and higher stress potential seam to promote a higher risk of somatization (cf. Howard et al. 1986, pp. 95)

4.2. Levels of comfort

Jaqueline Vischer (2008) created the "environmental comfort" model, which describes 3 different levels of comfort. The three tiers in a workplace are: physical comfort, functional comfort and psychological comfort. The most elementary level is the

physical comfort level, which explains the most basic elements at a workplace. In other words, a workplace where employees are able to breath, see, a comfortable temperature and not extreme noise destruction. However, even nowadays some modern office buildings do not provide such working atmosphere and fail in these points. The concept of functional comfort is located one stage above and describes, that a specific point of convenience increases the performance. The aim in this model is to distinguish between supportive and unsupportive surroundings. The focus of the employees should be on the actual work and not to struggle with basic elements. Due to that, supporting performance is in the foreground and not just increasing satisfaction. At the top of the pyramid is the so-called psychical comfort level, that deals with individual feelings. Personalization of the working environment is very important at this stage. Privacy and control over the environment, such as the ability to adjust light and furniture to personal needs plays a big role. Last but not least, many companies have to understand that investing into a proper workplace design makes people happier. Employees spend an enormous time of their life at the office and should be enjoying their work.

4.3. From satisfaction to productivity

It is a fact, that in the context of human relation's research the instrumental idea of increasing the productivity, by reducing time of absence and dismissal rates by increasing job satisfaction is of central importance. In the following chapter, the relationship between performance and job satisfaction is explained in more detail.

4.4.   Productivity

Porter and Lawler (1968) introduced a new model, which shows that satisfaction can increase the productivity. On the other hand, an increase of satisfaction is the result of successful performance. This can then be used as a booster for a future performance capability.
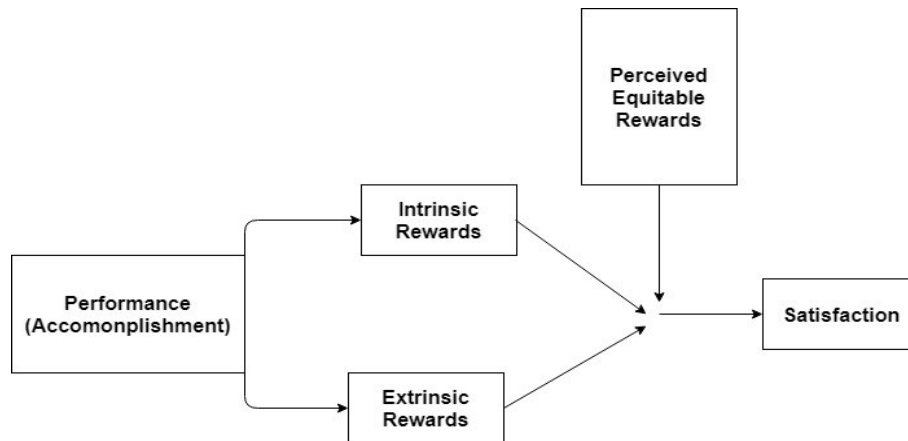
Figure 8 Porter model (1968)

A research done by CBE (Center of the Built Environment) demonstrates, that employees who like their work environment seam more productive. An increase of up to 4% productivity is possible by increasing the workers satisfaction by 15%. (cf. Berkely, 2012. pp. 3). Another connection to job satisfaction is, that the satisfaction of the management and salary is linked to satisfaction with the physical work environment. (G. Newsham, et al. 2009).

The human is able to adapt to a new environment, doesn't matter if she or he likes it or not. This can cause a negative impact on the productivity. However, individual design of the office can reduce stress and improve well-being of the employees. The empowering of the workers may be a factor to increases the overall satisfaction of the employees to keep them longer in the firm. Studies recommend, that this empowering of workers can lead to higher level of well-being. (cf. Craig Knight and Alexander Haslam. 2010, pp 158) Nowadays, the word sustainability plays a big role in an office environment. Statistics from Marlon Nieuwenhuis (2014) indicate, that a green office

leads to productivity. Some plants inside the room can increase the productivity by 15%. Looking at plants or the nature has a big impact on the human mind and should be envisaged by every company. (cf. V. Lohr, et al. 1996, pp. 97). Last but not least plants have a positive effect on creativity (cf. Larson, 1996, pp. 97).

The human mind is made up in a way, that it remembers negative impacts better than positive ones. (cf. Commission for Architecture and the Built Environment and the British Council for Offices. pp. 43) Due to that, employees, satisfied staff works up to 25% more efficient than unsatisfied employees (cf. Adrian Leaman. 2009, pp. 18-.20). Also lighting inside a room points out an impact on well-being. Researchers analyzed how the light influences employees and reveal, that at the end of the day workers with good lighting condition are in a better mood (cf. J. Veitch, et al. pp. 133)

The problems of open plan offices are nothing new. Corresponding to Vinesh Oommen (2008, pp. 37), the feeling of insecurity within the office comes along with privacy issues, noise and other distractions from other workers.   Such models as "one size fits for all" do not exist. The CBE noted that humans have different needs at their work station, and separate workplace zones for different types of people can optimize productivity (cf. Centerline, Summer, pp. 3-8). Standardizations can decline productivity. The environment is set up in a way, that employees feel more stressed and overloaded. This risk can influence negatively on performance. (cf. Christina Bodin Danielsson. 2013. pp. 167).

4.5.   Summary

To sum up humans are individuals with different needs. Individualization, privacy, eliminating distractions leads to a higher level of productivity which is important for the company and on the other hand for the users. The chapter above shows, that designing an office building in a smart way helps both sides. Hopefully in the future all companies are willing to invest in employee satisfaction.

5. Physical values

This chapter deals with the impact of physical values on the occupant`s productivity. The most important influences will be described below. These influences are: Indoor air quality, thermal comfort, lighting, acoustics, office layout, the look and the location.

5.1. Indoor air quality

The indoor air quality describes the quality of air inside a building. Statistics show, that air quality has a major impact on the employee's productivity. However, a building which provides a high level of air quality, works such as text writing and mathematics, are easier to do**.** (cf. Wargocki, 2000, pp. 222) Several independent studies demonstrate that, industrial air quality standards lead to dissatisfaction and to many different health issues. (cf. Mendell, 1993, pp. 246) Such health symptoms are, asthma, allergies and many more. These disputes are also called a Sick Build Syndrome. (cf. Fisk and Rosenfeld, 1997, pp. 158)

Air quality within the building is a complex topic. Humidity, temperature and air pollution are the 3 major components. The indoor air quality is also influenced by external factors. Climate, structure of the building, heating, ventilation and Air-conditioning systems, space arrangement within the offices and the type of work influence the quality of air. According to the complexity of measuring these factors, most of the indicators are variable. (cf. Szczurek et al., 2015, pp. 190)

It is proven, that a lower level of air quality leads to illnesses and regression of productivity. (cf. Wargocki, 2000, pp. 222) Studies of European countries illustrate, that a ventilation below 10 liters per second can lead to sick building syndrome and different other health issues. (cf. Seppänen et al., 1999, pp. 226) Indoor air quality is a very important and difficult topic and should be considered by the management. (cf. Lin and Deng, 2008, pp. 70)

5.2. Thermal comfort

Thermal comfort is defined as a *"state of mind which expresses satisfaction with the thermal* environment" (Ashrae, 2004). Comfort is an individual feeling and variates from person to person. It is a cognitive process, which is influenced by psychological and physiological factors. (cf. Lin and Deng, 2008, pp. 70) Depending on, clothing, windows, mood and various other factors, comfort is complex. (Ashrae, 2005) As already mentioned above, to achieve thermal comfort for everyone in a building is a very difficult task and variates from employee to employee. There is a broad range of factors which should be considered by thermal control. These factors are: sex, age, time of the year and lots more. (cf. Cena and de Dear, 2001, pp. 409) Surveys show, that the right design of a building makes employees feel more comfortable and efficient than others. (cf. Langevin et al., 2013, pp. 206) Six factors have a major impact on the thermal feeling. Metabolic rate, clothing isolation, temperature, humidity, mean radiant temperature and air velocity are the impacts on the human thermal comfort feeling. (cf. Macpherson, 1962, pp. 151) There is a difference in thermal acceptability and thermal preference. Thermal acceptability is the temperature where it is acceptable for the occupants. Thermal preference is the ideal and preferred temperature for a human. (cf. Langevin et al., 2013, pp. 206) The Literature indicates, that the occupant's satisfaction is increasing, the closer the thermal comfort reaches the thermal preference point. It also displays, that different age, sex and Body Mass Index have a different preferred thermal state. (cf. Tuomaala et al., 2013, pp.26) It is also proven, that women are more likely dissatisfied by thermal conditions than male. Especially in cooler conditions female occupants are more sensible. (cf. Karjalainen, 2012, pp. 96).

However, thermal comfort requires energy. Both heating and ventilation systems are responsible for reaching the right comfort level. (cf. Kwok and Rajkovich, 2010, pp. 18). Thermal comfort is a not easy task but influences the employees a lot. Is the thermal comfort not fitting, occupants productivity is decreasing. (cf. Roelofsen, 2015, pp. 1) There is a temperature range for office work. The temperature should be during the whole year between 21°C and 25°C. If this range is not provided every degree

above is a 2% productivity loss (cf. Seppänen and Fisk, 2006, pp. 957). Different researches show, that every task has its optimum temperature. Two different kind of mental assignments have two different optimum temperatures to be the most productive. (cf. Fisk, 2000b, pp. 537).

This subchapter presents, that thermal control is very difficult for every company, because every human has its unique way of feeling temperature.

5.3. Lighting and daylight

The daylight as a major impact on the human body. Over millions of years the biological clock needs daylight to work in a proper way. Day and night are something what the body remembers and is connected with light and darkness. The human body needs this routine for an optimum performance. (cf. Aries, 2005) Office employees work most of their time in the office and depend on artificial and natural light. Literature indicates, that natural light is the best source of light for working. The sun offers an excellent color rendering for the human and should be used for visual comfort. The brightness of the daylight influences the employees in a positive way (cf. Li and Lam, 2001, pp. 793).

Buildings nowadays consume nowadays around 40% of the total consumption of energy on the globe. Around 33% out of the 40% is just used for lighting and is the highest share. This display, that the society depends on artificial light and its importance. Nonetheless, artificial lightning causes co2 emissions and global warming (cf. Busch et al., 1993, pp. 197). An efficient use of daylight can reduce this process and the carbon footprint of a building. Companies, that value the gift of the sun achieve a higher productivity level of their workers (Yang and Nam, 2010, pp. 1513) Researchers advice to use natural light for office building, because occupants prefer this kind of light source the most. (cf. Galasiu and Veitch, 2006, pp. 728).

Getting daylight into the building is easy by installing windows. Therefore, a study was done and showed, that 99% of the office workers think, that windows are

important and 68% consider daylight as very important for doing their tasks. (cf. Cuttle, 1983, pp. 47). Windows provide information what is going on outside of the office. Such information is: nature, weather and surrounding activities. (cf. Heerwagen and Orians, 1984, pp. 138) By analyzing the daylight availability, special building design make it possible to increase daylight time in the office. This depends on the location, weather and time to get the optimum daylight that's possible. (cf. Yousef Al Horr et. al. pp. 16)

Satisfaction of employees is decreasing when improper lighting conditions occur in the office. Proper lighting and thermal condition make occupants more productive. (cf. Selkowitz, 1999, pp.13). Glare should be avoided, which can be caused by a high level of illuminance from daylight. (cf. Yousef Al Horr et. al. p. 16) Also the combination of artificial and natural light can cause glare. Smart lighting controls are needed to avert it. There are two different options, either to use a dimmer or a switch to turn light on and off. (cf. Chang and Mahdavi, 2002, pp. 147)

5.4. Acoustic and noise

Hearing is one of the five human senses. Noise control becomes a very important task in office buildings. To work efficient occupants, need a certain level of noise which has to be controlled. Special designs can improve the acoustics in offices. No loud noises may lead to dissatisfaction and a decrease in performance. (cf. Yousef Al Horr et. al. pp. 16). There are two different noises that can interfere the employees. On the one hand destructions from the outside, such as traffic or machineries, and on the other internal, for example, conversation of colleagues, telephone calls or technical equipment. (cf. Banbury and Berry, 2005, pp.25)

As already mentioned in the chapter "Thermal Comfort" an increase of 1°C, above 25°C, creates a productivity loss of 2%. There is the same issue with noise. An increase of 2.5 dB has the same impact as an increase of 1°C (cf. Pellerin and Candas, 2004, pp. 129). A higher noise level can cause a higher stress level. Therefore,

researchers recommend avoiding noise. Noise leads to higher blood pressure and stress hormones (cf. Evans et al., 1998, pp. 75). Both internal and external noise destruction can be brought to a minimum by smart internal arrangements and office layouts. Open plan offices may have a bigger problem with noise control, which can lead to a negative impact on performance and motivation. (cf. Jahncke and Halin, 2012, pp. 260) Sound absorbing materials within office rooms reduce the noise destruction. Special elements on the ceiling, walls and desks may help.

5.5. Office layout

The Layout of an office is one of the most important factors, that influences performance. Especially privacy, proximity and design have the biggest impact. (cf. Haynes, 20008b, pp. 189) Part of the success of a company relies on the proper suited office layout. Different studies show, that wrong office environment is related to productivity loss (Yousef Al Horr et. al. pp. 16).

5.6. Look and feel

The look of something nice has an impact on the well-being. Different colors, shapes and textures have an influence on office workers. Studies highlight, that the human reacts on different colors in a different way. (Yousef Al Horr et. al. pp. 20) Colors in offices affect the employee's productivity (cf. Öztürke et al., 2012, pp. 359). For instance, green makes occupants feel calms. (cf. Ou et al., 2004, pp.292).
Not just the color is important, also the texture of an object. Textures remain in the memory like colors and shapes. Therefore, the overall well-being is a combination of a well-shaped interior structure and color design.

The organizations' image is represented by the office design. A good example is, that a big atrium seems to be welcoming and an L-shaped entrance not. (cf. Yousef Al Horr et. al. pp. 20)

5.7. Location

Last but not least the location of an office site plays a role. Researches prove, that offices which are close to public infrastructure its occupants are healthier. The risk of obesity is increasing the further the site is away from public transport. More people are driving by car to work and the employees walk less. (cf. Yousef Al Horr et. al. p. 21). Such health benefits are positive for the employees also for the company, because people are less frequently sick. (cf. Gordon-Larsen et al., 2009, pp.1216)

6. Excursion New Ways of Working (NWW)

New ways of Working and working from everywhere is in today's fast changing world an often-discussed topic. The following chapter presents the NWW in detail, describes the changes and the advantages and disadvantages. Furthermore, the impact of NWW on employees and the company will be analyzed in detail. Finally, a study done by Brummelhuis et al. (2012) and wrike.com shows the benefits and challenges of working from everywhere

6.1. Introduction

In the last two decades huge steps in communication and information technologies were made. A few years ago, LTE was invented and now 5G is in testing phase. However, e-mail is the mostly used communication tool within the companies. Almost every company provides smartphones to their employees, which brings e-mailing to a new dimension. (cf. Demerouti et al., 2014, pp. 123). This new invention makes it possible to redesign the approach of work. New way of working describes, that workers can decide when, where and how they want to work. The aim is to increase productivity of the workers and to reduce costs at the same time. (cf. Rennecker and Godwin 2005 pp. 247)

6.2. New Ways of working

Baarne et al. (2010) describe new ways of working in three key characteristics. Whenever a worker wants to work he can work, that means that working hours are flexible. This implies, no fix working schedules are needed. Common schedules such es 9 a.m. to 5 p.m. do not impact on the employee`s work anymore. The second aspect of new working methods is, that employees are able to work from everywhere. The

traditional work at the office is possible, but also at home or on the way. No worker has its own working space that belongs to him. Instead plain offices places that suits to all employees are provided. Last but not least new technologies, such as videoconferences help to make working from all places possible.

Combining these three characteristics a new way of working is designed.

6.2.1. <u>Pros and Cons</u>

Communication with customers and colleagues via internet makes it easier and less time consuming, face to face meeting, which increases the efficiency. No road trips or booking meeting rooms are needed, just a smartphone. (cf., Berghel 1997, pp. 11). Smartphones revolutionized communication. Nowadays, smartphones are part of everyday life (cf. Hassan, 2003, pp.225). Statistics show, that mobile devices have a positive impact on productivity. (Baron, 2005, pp. 9) Another advantage is, that employees are provided with real time data, which makes faster decisions possible. The flexibility is improving their work life balance. The work has to be done, but the employees can work on their projects at night in the morning or in the afternoon. (cf. Parasuraman and Greenhaus 2002, pp.229).

However, New Ways of working also has its disadvantages. One drawback is the possibility of information overload. Such overload can lead to pressure on the employees. The feeling of always being available and answering emails as quick as possible can cause stress. (cf. Demerouti et al.,2014 S. 125). Studies show, that some employees feel isolated and have problems to work without structure. Disturbances of family members can cause a loss in productivity. (cf. Allen et al. 2003 pp. 125)

New ways of working have its advantages and disadvantages for users and providers.

6.2.2. <u>Impact</u>

New Ways of Working has an impact on the job resources and demands. According to Demerouti et al., (2014 pp. 127) NWW increases informational-, work—and social overload.

Information overload: Information overload occurs when the personal capacity of information is too much.

Work overload: This happens when the volume of information exceeds the time available.

Social overload: Receiving too many information of too many different people can cause social overload.

On the one side the continuous availability through mobile devices can lead to an increase in efficiency, but on the other side more work interruptions can turn into disorganization. (cf. Rennecker and Godwin 2005 pp. 247) The nonverbal communication through computer devices implies, that not all information is completely transferred. (cf. McKenna and Bargh 2000, pp. 57) The lack of verbal conversation may turn into misunderstandings. Literature of Contractor and Eisenberg (1990, pp.143) demonstrate, that electronic communication is replacing the face to face and overall communication. Due to the new ways of communicating, colleagues are spending less time together at the same place. Therefore, employees receive less support except over telecommunication.

The reason why more and more companies are introducing New ways of working is, to give the employees the opportunity to manage their work and family life on their own best way. Flexible time management makes the use of time of the employees more efficient. (cf. Parasuraman and Greenhaus 2002, pp.299) The possibility of choosing the location to work allows personnel to manage work and family at the same time. (cf. Gajendran and Harrison 2007, pp.1524) At the same time, users of telecommunication complain of a higher stress level, because of interference of family members (cf. Duxbury et al. 1996, pp. 1). Different empirical studies display a mixed picture on the effect of NWW. Gajendran and Harrison (2007, pp. 1524) mentioned,

that there is a small reduction of work and family conflicts by implementing new ways to work.

6.3. Studies of NWW

The following subchapters contains 2 studies of the impact of New Ways of Working.

6.3.1. Study of the impact of NNW on well-Being and performance

A five-day study of Brummelhuis et al. (2012) indicate, that NWW has a positive effect on the engagement, but a negative influence on the daily exhaustion due to efficient communication. The survey also reports that the availability of employees costs a lot of energy which exhausts them.

6.3.2. Study of challenges and benefits of remote work

In the following sub chapter statistics which were done by wrike.com will be presented. 500 companies participated in the study to examine their opinion about how they feel about virtual collaboration.

Results:
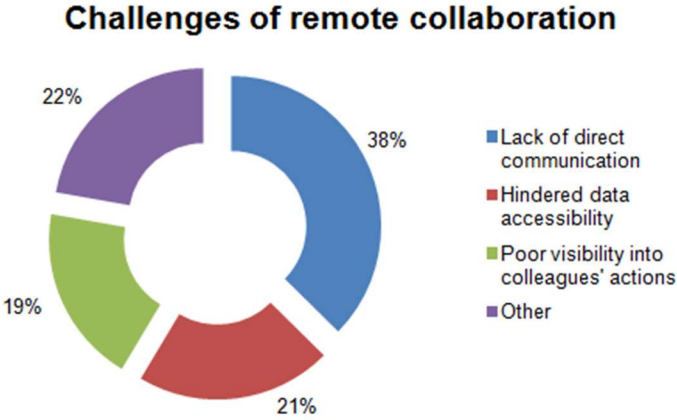
Table 1NWW Chellenges https://www.wrike.com/blog/the-past-present-and-future-of-remote-collaboration-where-does-your-team-stand/ (29.12.2018)
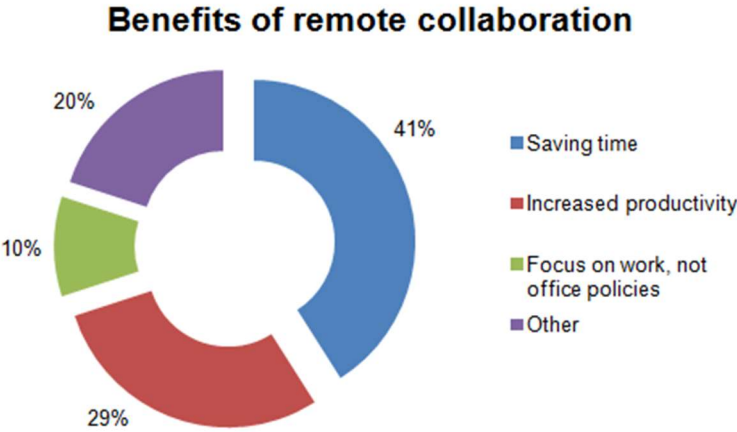
Table 2 NWW Benefits https://www.wrike.com/blog/the-past-present-and-future-of-remote-collaboration-where-does-your-team-stand/ (29.12.2018)

Do you work remotely more than 2-3 years ago?

Business owners	47%
Executives	50%
Managers	47%
Team members	36%

Table 3 NWW Usage https://www.wrike.com/blog/the-past-present-and-future-of-remote-collaboration-where-does-your-team-stand/ (29.12.2018)

7. Empirical research

The focus of this work is on the experiences of the employees and their recommendations to generate an expressive statement from the evaluation. A qualitative research approach was chosen to answer the research question. A total of nine persons were interviewed for this purpose in the form of expert interviews. The interviewees work in different office types to get a briefer insight of their experience in different office environments.

7.1. Research design

The research design is described in the following sections. For this purpose, the chosen research approach is explained and the creation of the interview guide, the selection of the interviewees, the conduct of the interviews and the evaluation of the data are explained.

7.2. Justification for the chosen survey method

The aim of this study is to explain human sensations. Therefore, the method for collecting data the method of interviews was chosen. Collecting data through interviews is one of the most familiar strategies. There are a lot of different approaches among interviewing. Interviews are used to know the asked person better. The aim of qualitative research interview is to collect knowledge, which are important for the research. (cf. Dicicco-Bloom und Crabtree 2006, pp. 314) There are three different types of qualitative interviews. These are: structured, semi-unstructured and unstructured interviews. (cf. Crabtree B and Miller W. 1999, pp. 18). For doing the

case study, the semi-unstructured method was chosen. According to the literature, structured interviews are not proper for this study, because it generates quantitative data. On the other hand, unstructured interviews are interviews, which are similar to guided conversations. Therefore, the author chose a mixture of structured und unstructured, the semi-unstructured interview method. Typical for this method is open end questions. Semi-unstructured interviews are the mostly used methods for quantitative research. There are two options to do this kind of interviews. Either to do individual interviews or in groups. For the following case study individual talks with the interviewed employees were chosen. (cf. Dicicco-Bloom und Crabtree 2006, pp. 315) Individual in-depth interviews allows the researcher to get a deeper look into personal matters and creates a broader range of opinions. (cf. Johnson J. 2002, pp.103) The basic research question should be at the beginning which are supported by 5 to 10 supporting questions. Questions which do not relate to the topic can be eliminated and replaced by new questions (cf. Dicicco-Bloom und Crabtree 2006, pp. 316). Providing a comfortable and safe environment for interviewees can lead to honest answers. Establishing a certain relationship between the interviewer and the test person is something essential. (cf. Miller W, Crabtree B. 1999;89–107). Apprehension, participation, cooperation and exploration are the stages of creating rapport. (cf. Spradley J, 1979;78–91)

To sum up the author chose the semi-unstructured interview method with individual talks to provide a safe environment. In the following chapter the interview partners will be described.

7.3. Development of the interview guideline

In order to cover all relevant topics in the interview, an interview guideline was developed. The preparation of the interview guide was preceded by preliminary considerations of the author. Based on the central research questions, various

dimensions have been defined. To every dimension specific criteria were allocated. Resulting of the dimensions the key questions were created. The following table shows the different dimensions and the resulting questions.

Dimension	Kategory	Key questions
Facts about the persons	- Name - Function - Office typ	- In which office type do you work? - How many employees work with you in the office?
Space and workplace arrangement	- Disturbing factors - Spatial narrowness - Effects on productivity - Effects on satisfaction	- Are there any customization options in the office? Personal items? - How does your office influence the way you work? Why? - What would you improve in your office? Why? - Are you satisfied with the layout? - Would desk-sharing be an option for you? If No, why not?

Physical values	- Temperature - Acoustics - Furnishing - Ergonomics - Lighting	- How do they perceive noise and noise pollution? - Should there be any changes in the equipment of your workplace? - How are the lighting conditions in the office? Do they prefer natural or artificial light? - How do you feel about the temperature in your office? - Is the ergometry of the furniture suitable for you? - Are there any other disturbing factors?
Social interaction	- Social cohesion - Communication - Informal communication - Meetings	- How is the social cohesion in the department? - Is the closeness of your colleagues important? - How does communication with your

		employees take place?
		- Where does informal communication take place? Is it important for you?
		- How many meetings do you have per day? Where do they take place?
Privacy	- Acoustic privacy - Visual privacy	- Is privacy in the office important to you (acoustically, visually)? Does this affect your well-being, satisfaction and productivity?
Grading, Recommendations	- Grading 1-5 - Future recommendations	- Are there any planning recommendations? - How would you grade your office and the communication areas?

7.4. Interview procedure

The researcher tried to avoid inconveniences and to make the interviews as comfortable as possible. If the circumstances allowed it a place was chosen, where the interviewees are alone. The questionings were scheduled for about 60 minutes, but on average they took around 50 minutes. Before the start of the interviews, the researcher explained the subject area, the role of the researcher and the type of interview. All employees, that participated at the survey were assured of a confidential handling of the data. A declaration of agreement, which included recording the participants, noting down what was said, was established and signed. Any other questions from the employees were answered before the interview. The researcher tried to create a safe and comfortable environment.

For introduction the researcher asked the interviewees some general opinions about the office building and explained his own opinion about the office environment, that the participants get used to the situation and feel open minded. After more detailed questions, which are interesting for the research questions were asked. Depending on the interview partner, spontaneous questions came up. Answers which did not correspond to the core question were not noted. At the end, the interviewees had the chance to summarize all the positive and negative aspects and to add something what they didn't mentioned before. Very important was, that the flow of the conversation was not interrupted during the whole interview.

7.5. Pretesting

For testing if the pre-draft questionnaires are in the right order and that the outcome refers to the research question a pretest was done. The employee is working in the same company where the survey was done and has already a deeper knowledge about the company's culture. The pretest showed the duration of the interviews and the

possible answers. The test person was particularly inspired by the research field, because he usually was asked about the needs of an office room. He explained that previous interviews were mostly about storage needs, but never about the personal feeling in an office environment. The employee described that he was feeling very comfortable during the interview, because no colleagues were sitting beside him and that he could talk free about his working circumstances. To start with the opinion of the researcher, about the environment, helped him to get into the topic and to understand what the survey is about. Comments from the test person and additional topics resulting from the discussion process were included in the reworking of the interview guideline and procedure. In this way, the terms job satisfaction and performance were explained to the respondents before the actual start of the interviews. The pretest also showed that there were certain concerns about anonymity. To eliminate this concerns the participants were told, that this data will be anonym and no names will be mentioned in the results, personal data will be just available for the researcher and the interviews and voice memos will be deleted after the survey. Since the pretest showed that the interview guideline and the questions are understandable, in the right order and in forecasted duration, not many changes were needed.

7.6.   Description of the interviewees

In depth interviews are used to get a deeper insight of common understandings. The asked interviewees should show similarities related to the research question. (cf. McCracken G., 1988; pp. 16). Adams et al. (2002) Suggests interviewing different people, with different age, gender, to have a broader range of results for research purposes. By selecting the interview partners, care was taken to choose people who do not have the same opinion about the asked questions. Therefore, employees with different gender, experience and office type were chosen.

Interviewee	Office type	Gender	Age	Working hours per week	Experience
1	Cellular office	Male	35-44 years	Full-time	>20 years
2	Cellular office	Male	25-34 years	Full-time	0-4 years
3	Individual office	Male	45-54 years	Full-time	10-14 years
4	Group office	Male	25-34 years	Full-time	5-9 years
5	Individual office	Male	45-54 years	Full-time	0-4 years
6	Cellular office	Female	35-44 years	Full-time	0-4 years
7	Group office	Male	45-54 years	Full-time	>20 years
8	Cellular office	Female	35-44 years	Part-time	15-19 years
9	Group office	Female	45-54 years	Full-time	>20 years

For reasons of anonymity, only the information shown in the table above is given. None of the test persons are working in an open-, non-territorial- or multi-space office. All employees have their own working station which is shared with no one else. Every interviewee is working in the same office building.

7.6.1. Graphs of the different factors of the asked employees
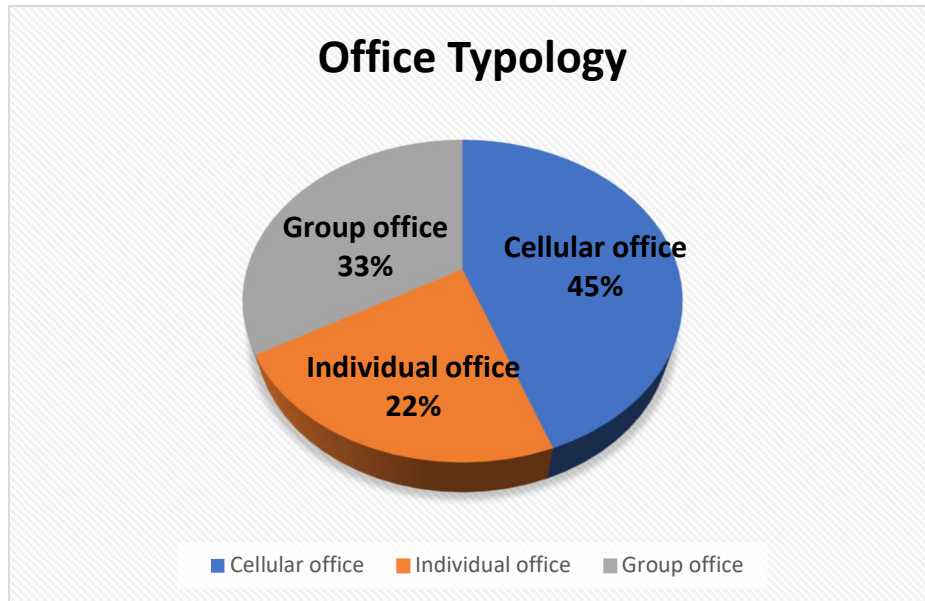
Table 4 Office typology (own figure)
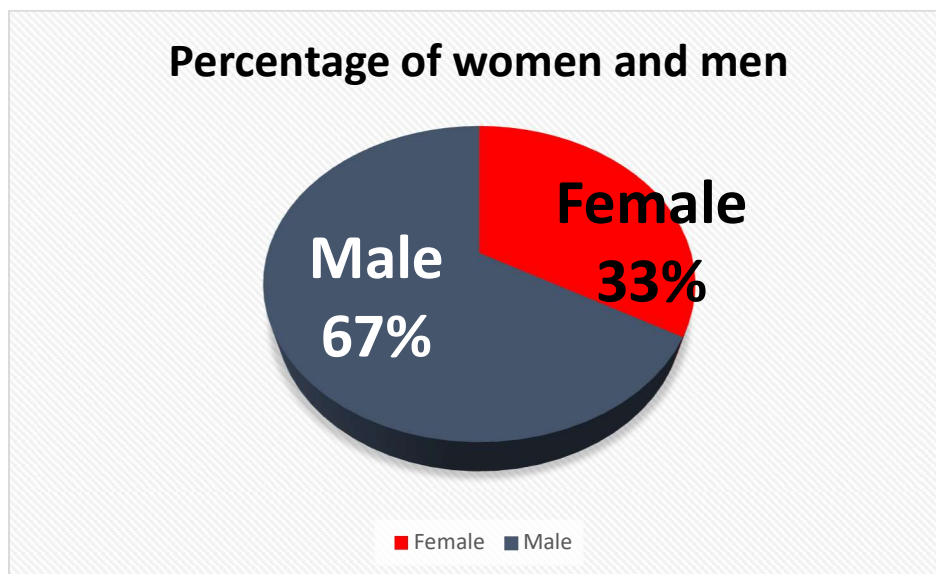
Table 5 Men and Women (own figure)
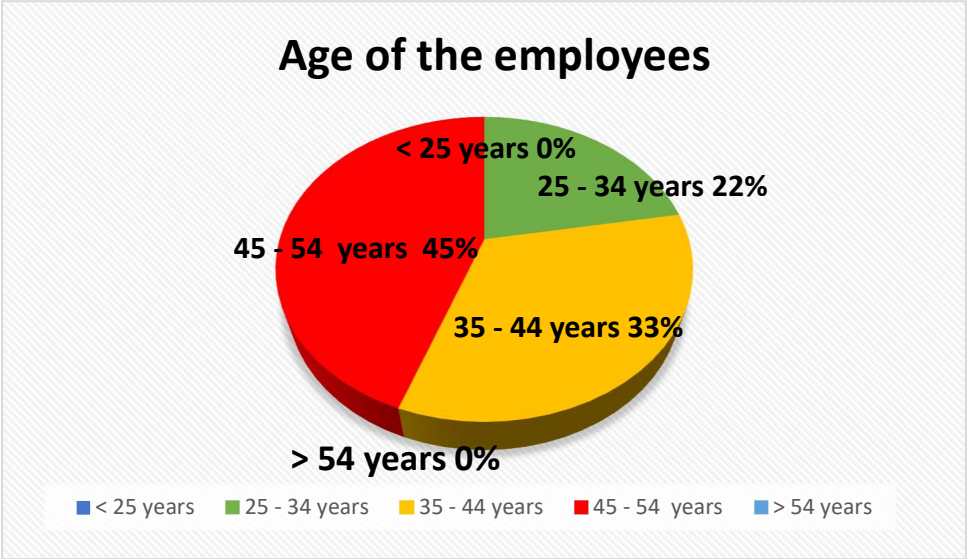
Table 6 Age of employees (own figure)

Table 7 Full-time vs. Part-time (own figure)
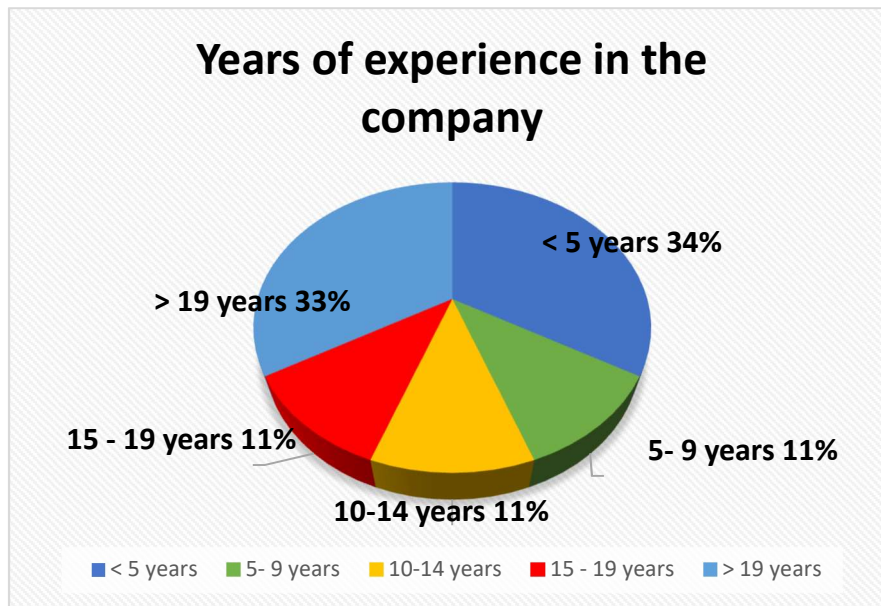
Table 8 Experience of employees (own figure)

7.6.2. Analysis of the graphs

Three women and six men were asked. One of the women is working part-time. The different office typologies are almost even among the tested persons. The statistic also shows that around 45% of the employees are older than 45 years old. The last pie chart shows that in the last 5 years a lot of new workers were employed.

7.7. Data Analysis

For preparing the results of the analysis the notes of the interviews were added by using the audio memos. Not the whole memos were transcript, just the relevant information and topics. No changes were made to the transcriptions. Nagel (cf. 1991, pp. 455) suggests, to transcript just the topics, that are relevant for the researcher. Therefore, sections which do not correspond to the research question were deleted and not added to this paper. Topics which do not deal with office design, physical values

and employee's satisfaction or efficiency were deleted. At the same time answers of the interviewee which were not allowed to publish, because of anonymity were erased. To interpret the interviews, qualitative content analysis of Mayring (2008) were chosen. The aim is to provide unclear texts with additional material for a clearer understanding. This summary focuses on the most relevant topics according to the research question. For getting a better understanding a technic for analyzing qualitative interviews was selected. This technic helps the researcher to pick out the relevant answers from the survey. (cf. Mayring, 2008, pp. 90). System categories were established, which contains main- and subchapters. This scheme structures the employees answers and assigns them to the different categories. Furthermore, meaningful sayings were implemented into the system to underline the literature review.

For establishing the categories and evaluating the interviews the method of Mayring (2008) was used. The following flow chart describes the different steps:
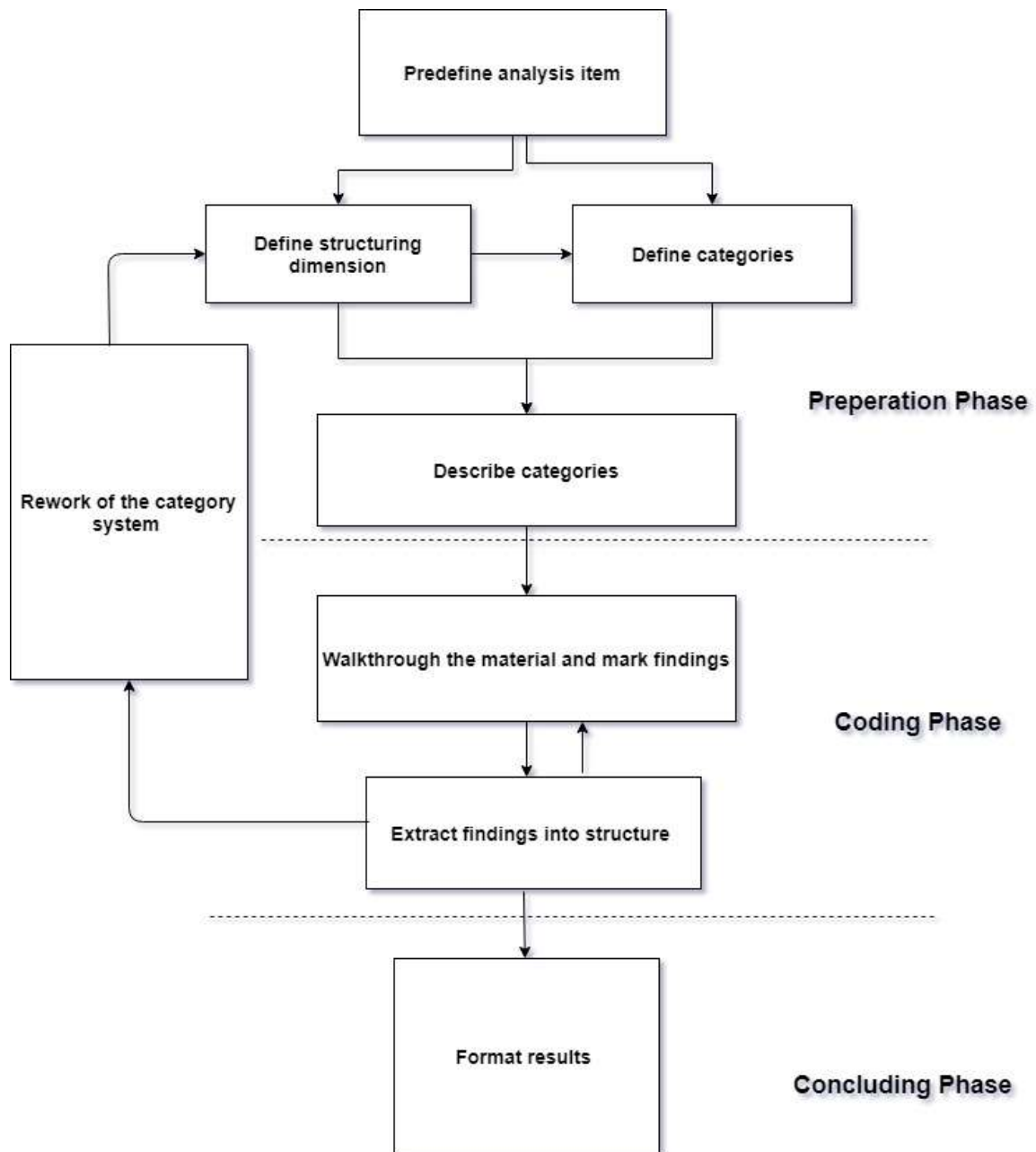
Figure 9 process flow of a structured content analysis (Mayring, 2008, p.84)

After the methodological foundations of this study have been presented, the results of the survey are described in the following chapter.

8. Results

The evaluation was based on the Mayring summary method. Mayring defines the aim of this method as follows: The aim of the analysis is to reduce the material in such a way that the essential contents are preserved, to create a manageable corpus through abstraction, which is still an image of the basic material (cf. Mayring, 2010, pp.65.). In the course of the evaluation, attempts were made to work out common features. The reduction of the collected material was carried out according to a category system. This was built up on the basis of theoretical assumptions.

Categories:

- Personalization of the workspace

- Layout

- Typology

- Noise pollution

- Lighting conditions

- Thermal comfort

- Ergonomics and equipment

- Communication areas

- Culture

- Privacy

8.1. Personalization of the workspace

Seven employees use the option to personize the office environment. Most workers prefer pictures of the family on the desk or on the computer as screensaver. Plants are something common and in every office room. One office desk was very special, more

than 10 plush toys where located on the table.

Two workers didn't change anything at their place. One of them (Employee 5) joined the company recently and dint have time till now to hang up some private photos. He wants to do it when he has time for it. Employee 6 sees the working space as a working place and doesn't need private things around her. She says that it is a place for working and not for living. The Office, that didn't change anything has a different opinion.

"I am not a fan of family portrays, this is a working place and the family is at home. I like the plants which I got for birthdays, but I wouldn't buy them by myself." (E. 6)

On the other hand, Employee 3 Mentioned that Plants are very important for him, because he likes nature very much and rooms with plants have a better climate in the summer and winter. Another interviewee said:

"I prefer to bring as many personal things from home as possible. I use my one pen from home and even have the same plants in the office as at home and this helps me to feel more comfortable at work." (E. 7)

The workers were also asked if they think that a personalized working space has an impact on their satisfaction and performance. Around 67% think that a privatized office environment makes them feel more satisfied than a bare office room.

"I perceive that an adapted office affects the harmony in the office." (E. 1)

One respondent was not sure if the personalized atmosphere makes him more productive but mentioned that he is more satisfied when he sees pictures of his family. The two employees who don't have any personal objects in the room also think, that there is no link between personalization and productivity.

"I don't think that pictures of my family would make me happier or more productive. I never had it in any office and I will not have it in the future." (E. 6)

8.2. Layout

Five out of nine people that were interviewed are not happy with the current layout of their rooms. One of them is in a management position and is sitting in a group office.

"We purposely planed a group office and not a traditional cell office to improve the communication. Now we are unhappy with it and I am thinking to divide the office into two rooms. Sometimes it gets very noisy. (E. 4.)

Another employee complained that she has too less space and can't move properly with her chair.

8.3. Typology

Most of the people are very happy with cell offices. Employees which are working in group offices would like to change to cell offices. One person thinks that the cell offices kill the communication between the colleagues within the department.

"Most of the time I leave the door open, because otherwise I wouldn't see my colleagues for the whole week. I think glass elements would be a good start to increase transparency and communication. (E. 6)

One employee mentioned that he would like to sit in a single office.

"I am a passionate loner and prefer to sit alone, telephone calls disturb me a lot."
(E. 1)

All employees said that they never want an open office.

"An open office is a no go for me!"

8.4. Noise pollution

For all respondents, a quiet working environment is a requirement for being able to work concentrated. A low noise level is essential, especially for difficult work. Persons who work in an individual office unfortunately didn't complain about noises. Four employees are annoyed by the isolation of the walls.

"I am able to hear a lot from the office which is next to this office, but it is not understandable" (E.2).

Two others that are working in a group office mentioned that the acoustic level is very high.

"If three people are talking one the phone at the same time, which happens pretty often, I am not able to understand and concentrate on the phone call." (E. 9)

Under these circumstances, it is difficult for E. 9 to concentrate, which makes her less productive. On the other hand, some employees are very happy with the noise conditions.

"We even leave most of the time the door open to hear what's going on and to stay in contact with colleagues." (E. 6)

8.5. Lighting conditions

All employees that work on the 2nd level or higher are very pleased with the lighting conditions inside the room. The interviewees particularly appreciate the high amount of daylight as well as the view from their offices. One test person from the 1st level said that it is too dark in his group office.

"A few years ago, the sun reflected from the monitor, so we glued a special foil onto the windows to be able to work. The outcome is that the screen does not reflect any more, but its darker the whole day." (E. 4)

The table of Employee 9 is located the wrong way in the room. The result is, that the window is behind her back and the sun from outside is shining on the monitor. This person has no possibility to turn the monitor, so the sun is sometimes temporary disturbing. Artificial light is perceived as very pleasant.

"I am happy that there are no spot lamps on the ceiling because I prefer the indirect light." (E. 5)

8.6. Thermal comfort

As a preliminary point every office can be controlled individually and all tested persons except one think that this is very pleasant and necessary. Most of the participants say it's good to have. Employee 3 thinks different:

"Not every single office room needs to be adjustable because there is still the option to wear e pullover when it is cold or to take it off when its warm." (E. 3)

Employee 1 is complaining that it is most of the time too cold in his office, but that's because of his colleague who likes it cold.

"You always have to make compromises with your roommates." (E. 5)

8.7. Ergonomics and equipment

All respondents mentioned, that the ergonomics of the furniture is very important. The standard table in the company under consideration is not easy adjustable in height. Therefore, four people would like to switch to an eclectic adjustable table.

"With an electric adjustable table, I would be able to work standing" (E. 1)

Others prefer to work sitting and would not use such option. Seven out of nine who were asked, have two monitors on their tables and are really satisfied with it. They would not want to work on one monitor any more.

"Two monitors are very important for my type of work. Analyzing huge floor plans on one monitor would be impossible." (E. 1)

Some offices are equipped with printers within the office others need to walk to print-stations, which are located in the corridors. On the one hand people prefer to stay in the office and on the other employees would not want to have a printer near them. because of the air pollution. These workers prefer to stand up and walk a bit during the working day.

"I like it. that I need to go in the corridor to print, because there I meet my colleagues sometimes and the whole day to sit at the desk is not healthy." (E. 6)

8.8. Communication areas

The contact between the colleagues is most of the time in the office rooms. If people from outside of the office are needed for discussions, conference rooms are booked.

8.8.1. Kitchenette

All tested persons that work in this apartment complained about the lack of communication areas.

„Informal communication is very important for the whole department. Usually I meet my colleagues in the secretary office to get a coffee and keep in touch with the other employees. "(E. 6)

Most of the interviewees explained that they never use the small tee kitchen.

„I just go into the kitchen to put my dirty dishes there but nobody of our department is ever there. The environment is not nice, and the tea kitchen is too small for more departments. Other departments have their own coffee machines there, so it seems to me that this kitchen doesn't even belong to us. "(E. 5)

8.8.2. Typology

One employee sees the cell office typology as a reason for lack of communication.

"On the one hand I really enjoy the separation from the other colleagues. Two persons in one room is perfect for concentrated work. On the other hand, if I don't leave the door open it can happen that I see my colleagues not even once a week. "(E. 6.)

The interviewees with individual offices mentioned that they have the opportunity for spontaneous conversation with other employees.

"The type of work what I a am doing just an individual office is possible." (E. 3)

8.9. Culture

The statements of the asked persons showed that no conversations take place in the corridors.

„If we are standing in the corridors and talk, other employees think that we have no work to do. "(E. 1)

Others explain that over several years' groups formatted, that are drinking coffees together.

„The typology has nothing to do with group formatting. I usually drink my coffee after lunch, but always in the same office with the same people. "(E. 3)

A worker who is already working for longer than 20 years for this company told that the fusion of different companies is the reason for not as good team work as it could be.

"It's unfair, that employees who joined the company because of a merger of different companies get paid much more than people from another previous company. Years ago, it was not possible that employees from different former firms sit together in one office room. "(E. 1)

8.10. Privacy

This main category includes all statements on acoustic and visual privacy in offices. The results of the individual sub-categories of the category system are presented below.

8.10.1. Acoustic privacy

All asked persons except one explained that acoustic privacy is important for them.

"I am at work, so I don't have private talks except with my boss and therefore I go to his office, which is an individual office." (E. 6)

Other employees complain about their privacy situation and that there are no areas where to talk confidential on the phone.

"I am sitting in a group office and for some telephone calls I need to go to the corridor or find some other place in the building." (E. 2)

8.10.2. Visual privacy

All respondents stated that it is important for them that no one can look at their computer screens. In principle, the majority of their work content is intended exclusively for them and shouldn't be seen by other employees or external people who come to the office. Respondent 7 commented as follows:

"I am sitting in the middle of the room and the tables are arranged in a way that my colleague behind me can see what I am doing on the computer. At the same time people who open the door are able to watch my screen. This is very uncomfortable."
(E. 7)

8.10.3. Impact on the work

Respondent 3 described his need of an individual office as follows:

"This office is very important for the whole company. Nobody is allowed to enter the room without permission. In the office the access control of the whole firm is provided, and a theft of things would be a very serious problem." (E. 3)

The test persons also addressed the aspect of work efficiency. Not only privacy is important to them, also how they reach it. Interviewee 7 described that he would need a different office to be more satisfied in his work. He would be more efficient if he would sit in an office with maximum of two people.

"It would help a lot to sit together with the person in the same office who is working together with me." (E. 7)

The interviewees described the impact of privacy on their satisfaction and well-being at work. Employee 8 reports that some workers are sitting in the wrong room together.

"If the executive would change the seating arrangement some work, and processes would work easier and faster." (E. 8)

8.11. Summary

Overall most of the people are satisfied with their current work environment within the office. The communication areas which are already discussed above are not in the condition how the workers would wish them. Some have the thoughts that areas for informal communication is not given.

The interviewed persons graded the office rooms and communication areas from 1-5. 1 is the best grade and 5 is the worst.

	Geade 1	Grade 2	Grade 3	Grade 4	Grade 5
Satisfaction of the office roome	1	5	3	0	0
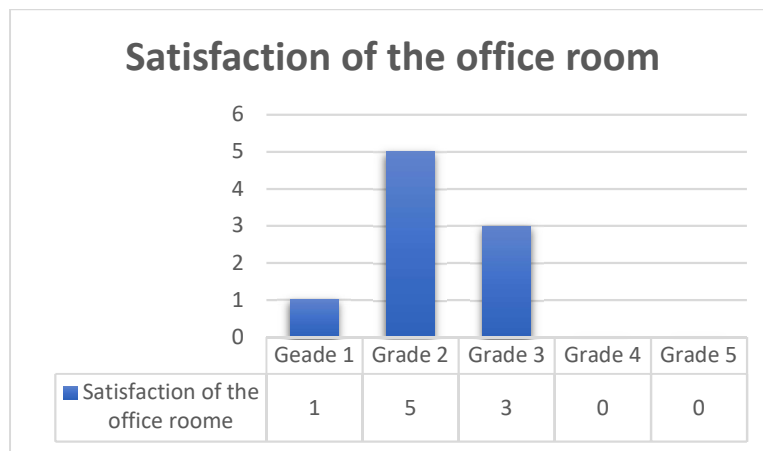
Table 9 Satisfaction of the office room (own figure)

	Geade 1	Grade 2	Grade 3	Grade 4	Grade 5
Satisfaction of the communication areas	0	0	1	4	4
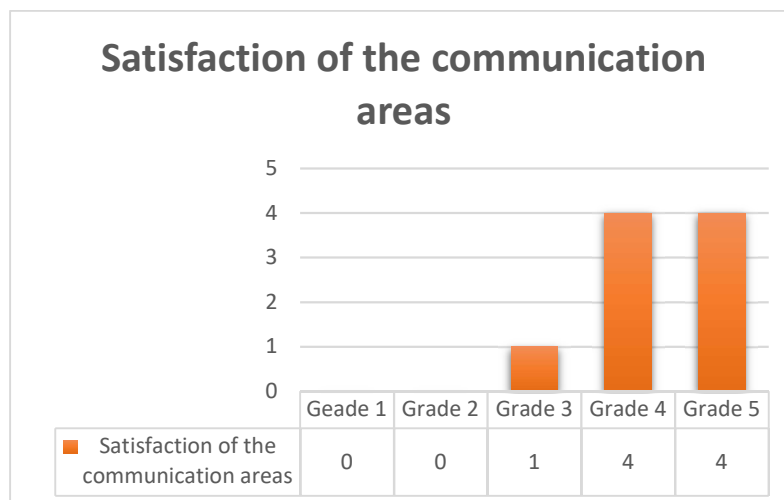
Table 10 Satisfaction of the communication area (own figure)

9. Recommendation for future planning

In the following chapter, the advices of the employees to optimize processes will get a deeper look.

9.1. Example of office rooms.

All four examples of new office rooms were tested within the company. In the following chapters the different offices will be presented and evaluated by the employees.

9.1.1. Example 1.

This office consists out of three tables, three pedestals, one movable ark, a wardrobe and two floor lamps. The tables are height adjustable without any tools, but it is not possible to work standing.
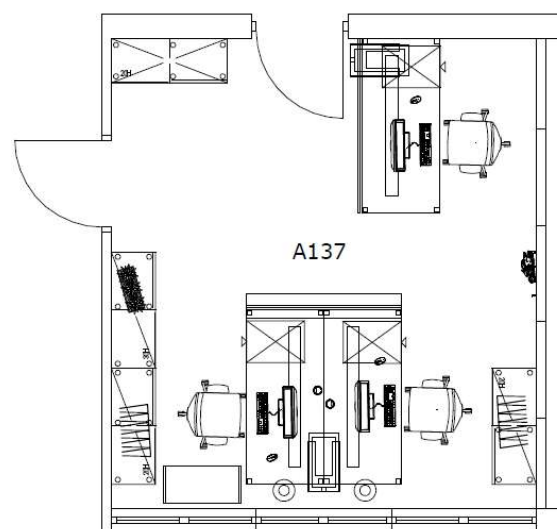
Figure 10 Office example 1(own figure)

Figure 11 Office example 1(own figure)

Evaluation of the employees

The employees which are working in this room at the moment noticed, that dust is seen very easily on the light surface of the tables This makes the office room seem dirty. Also, the frame of the table is designed in a way, that the employees who are working at the computer hit their knees during it.

On the other hand, they enjoy the color design very much. The previous color was grey and the new one is orange, which they could choose by themselves.

9.1.2. <u>Example 2.</u>

This new design consists out of three easy adjustable tables. These are not designnd for working standing. For decreasing the noise level acoustic elements between the workers were installed.
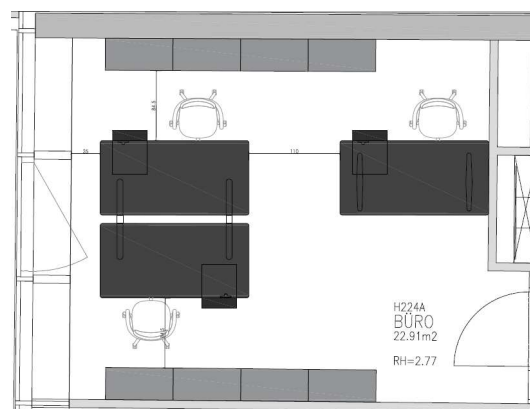
Figure 12 Office example 2 (own figure)

Figure 13 Office example 2 (own figure)

Evaluation of the employees

The test persons complained about too less storage shelves und that dust is very noticeable on the desks, which was also a problem in the previous example. According to the employee, the acoustic elements do not help to decrease the noise level and obstructs the light at the working place. On the other hand, the interviewees enjoy the modern look and quality of the furniture.

9.1.3. Example 3

Very noticeable is this office design. Work stations are divided with pin walls. In this office two people are working. Both have its own desk which is very difficult height adjustable.
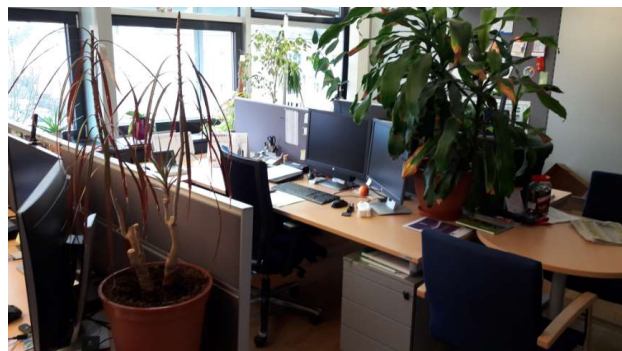
Figure 14 Office example 3 (own figure)

Evaluation of the Employees

The not easy adjustable table makes the employees always to sit in the same position all the time.
The visual separation has also the advantage to pin things on it and serves as an acoustic element at the same time.

9.1.4. Example 4

The last office room what will be presented is the office room with the most changes. All tables were switched to electronic height adjustable tables, which makes it possible to easily adjust the height during a working day. Standing work is also possible and gives the employees a lot of possibilities how to work. A printer was installed, because walking to the print station is not possible for their type of work. Last but not least bulletin boards were installed to hang up information what the employees need every day. The boards can also be used to for private pictures.

Figure 15 Office example 4 (own figure)

Figure 16 Office example 4 (own figure)

Evaluation of the employees

Because of the new chosen color, the employees like the new environment very much and enjoy the friendly atmosphere. The special tables are also used in its way to work in different positions.

9.2. Redesign of the communication areas

In the following sub category, a new design of not used spaces in the office building will be presented.

9.2.1. Example 1
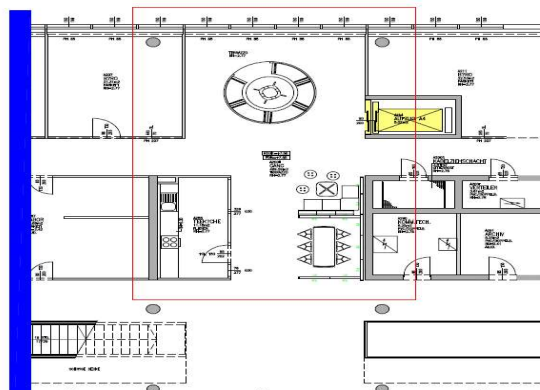
Figure 17 Corridor Example 1(own figure)
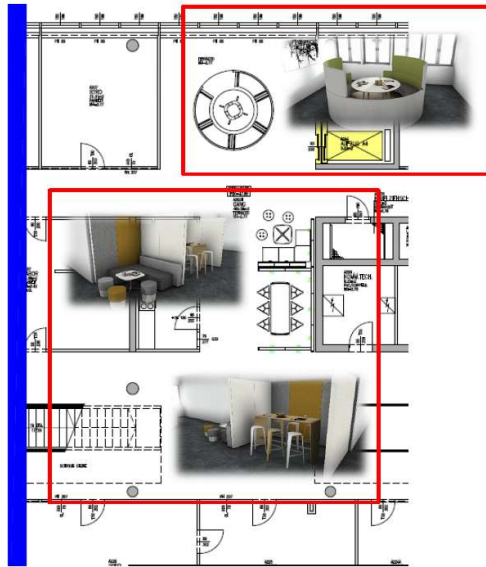
Figure 18 Corridor Example 1(own figure)

Close to the elevator between two office rooms a new office environment could be created. A meeting zone for formal and informal talks with a modern look can help too loose up the strict structure of the cell offices. The closeness of the tee kitchen invites the employees to stay in touch with each other and have a cup of coffee together. People who had lunch in the office rooms, would have the opportunity to join other employees who don't go to the canteen.

9.2.2. Example 2
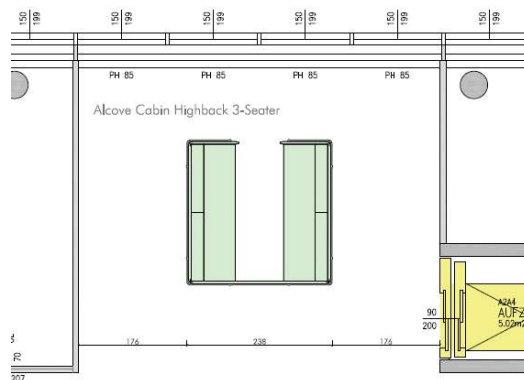
Figure 19 Corridor Example 2 (own figure)

Figure 20 Corridor Example 2 (own figure)

This is the chosen variant of the firm. A meeting place with visual division to other people where spontaneous meetings without booking a meeting room can be held. Acoustic privacy is not given but provides workers who work with a laptop to change the place for some time. The only disadvantage in this meeting area is, that no plugs for laptops or other electronic devices is provided.

9.3. Corridor redesign

At the moment the corridors are empty. A design with various comfortable sitting places was designed. Functional waiting areas in front of the offices and close to the kitchenette may help to improve the employee's satisfaction in various ways. Strict structures would be broken with a zone for chatting and meeting colleagues. In the following two examples of re-designed corridors are shown.

9.3.1. Example 1
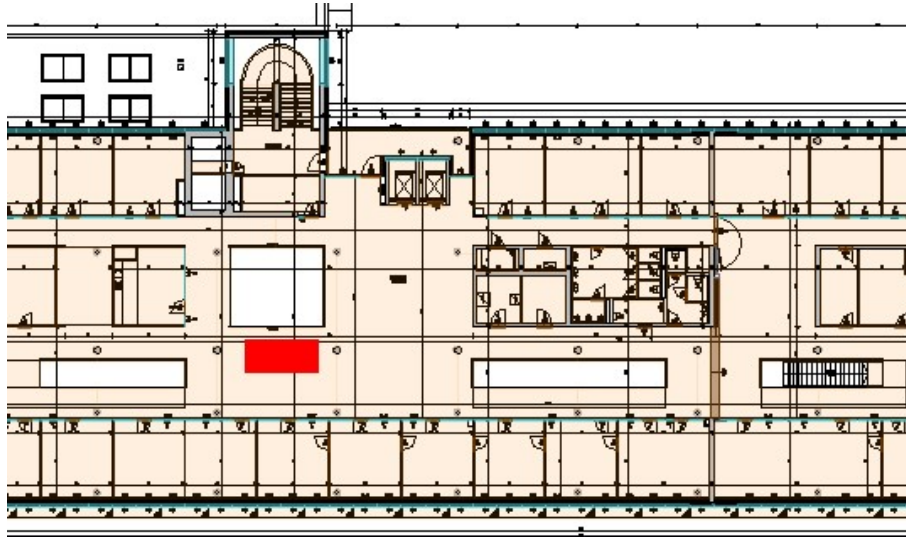
Figure 21 Corridor Example 1 (own figure)

Figure 22 Corridor Example 1 (own figure)

9.3.2. Example 2
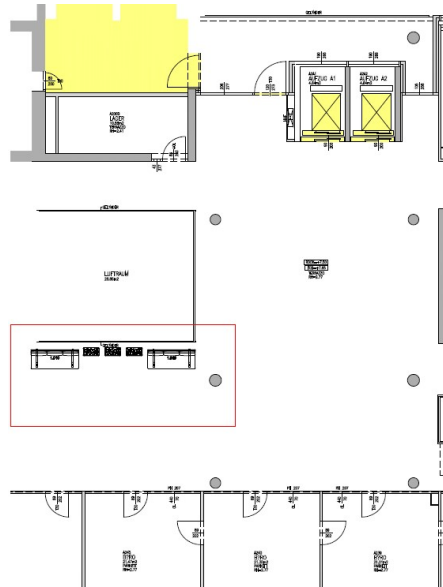
Figure 23Corridor Example 2 (own figure)
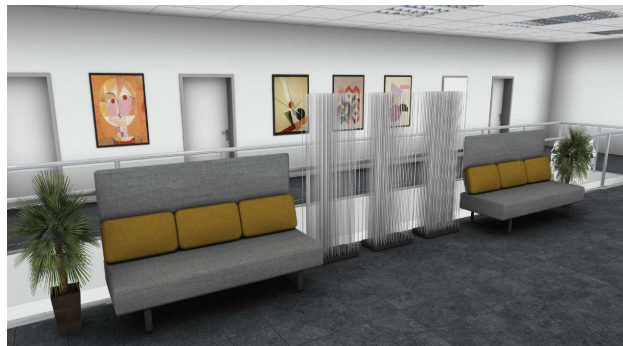
Figure 24 Corridor Example 2 (own figure)

9.4. Tea kitchen

The kitchenette is a very important meeting point in every company. Employees are meeting to talk about work or just to stay in touch with other colleagues. As already presented above in the results the tea kitchen is not used, because of it´s not inviting environment. At the same time the kitchenette is too small for more than one

department. In the following illustration, a new concept was developed to increase the satisfaction of the employees to make the kitchenette more attractive for them.
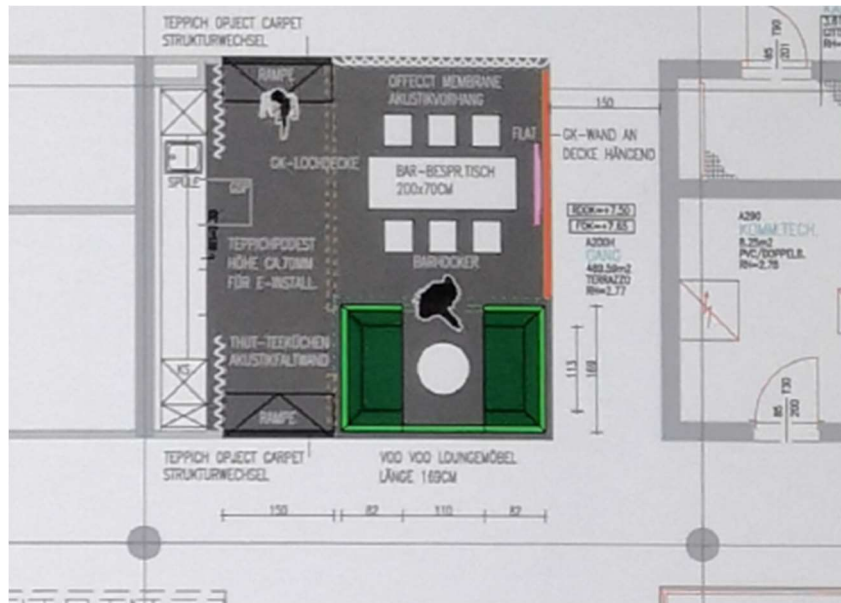
Figure 25 Example of the tea-kitchen (own figure)

The modification of the kitchenette includes the removing of the existing glass wall, setting up a new wall, which increase the floor plan size. A cozy meeting place with visual boundaries gives the employees the possibility for informal meetings with internal and external workers. Close to it a table with six places to sit would be created to provide place to have lunch in the tea kitchen. To sum up this would be a perfect solution to increase the communication and satisfaction within the firm especially in departments with a lot of cell offices.

10.   Discussion

In the following, the research question of this work is answered by discussing the empirically determined results and comparing them with the research results of the theoretic analysis. The aim is to determine how the results of the survey agree with the literature. In the following chapter the central research question will be answered.

Does the Office design effect the occupant's productivity?

The chapter is divided in different subchapters to understand the impact of different factors in the occupant's productivity.

10.1. Layout

Literature indicates, that a proper office layout is very important for employee's efficiency. Productivity is also related to the shape of the office environment. According to the survey, all people were concerned about open plan offices and the used cell offices. Scientists recommend a mixture of both office typologies. In today's fast changing environment also, the organizations are changing. All changes within a company mean also a change in behavior and its workforce. Providing privacy to occupants is a must, but at the same time the layout should be adjustable for future changes. (cf. Alhorr et al. 2016 pp 28)

In this context, the survey which was taken reflects not the same attributes. Workers mentioned that open offices are a no go for them. Some of them already worked in an open structure and mentioned, that they prefer the cell office structure. This can be because the company in which the survey was done is a public company. As already mentioned in the chapter office typologies, usually companies which are owned by public have strict structures and are not as open minded as private companies. This doesn't mean, that open offices do not exist in the public sector but rare.

Not to forget, the office layout shows the organizational culture. A well-designed office fits to the employees work to reduce tensions to a minimum. This leads to an optimum of productivity.

10.2. Look and feel

An attractive looking office always depends on the audience. This relies on the colors and textures that are used in the office building. Researches display, that the look of an office has an impact on its tenancy's performance and well-being. (cf. Alhorr et al. 2016 p30)

In this case interviewed persons complained about the boring gray of their offices. Therefore, different sample offices were created, to test if a new looking environment makes employees more satisfied to do their job. Here the literature matches with the survey of the new office rooms. The employees who work in that offices prefer the new look.

10.3. Thermal comfort

For this chapter, a lot of literature is available, which is related to thermal comfort. The thermal comfort depends on the temperature, humidity and the radiant temperature. Most of the researches agree with this. On the other hand, everybody has its own preferred thermal comfort zone. This depends on the age, gender clothing, weather and many other different factors. However, the suggested range for office work is between 21°C and 25°C. This thermal standard is a good point to start to find the optimum comfort level for most of the tenants. Not to forget, one comfort zone doesn't fit for all people on the globe and depends on the local climate. (cf. Alhorr et al. 2016 pp.26)

The company which was tested in didn't have any problems with the thermal comfort. Every office can be controlled individually, which leads most of the time to preferred temperature. In rare cases it doesn't fit but this depends on how many employees work together in one room.

10.4. Lighting condition

Literature highlight that, lighting has an impact on the employee's productivity. Therefore, the light from the sun is the most important source of light. Office buildings should be designed in a way to use this source as efficient as possible, to reduce energy costs. As already mentioned in the chapter 5.6.5. (lighting conditions) lighting is one of the biggest cost factors in a building. However different tasks need a different kind of lighting level. It is recommended that a certain amount of lux is provided for these tasks. Too much light can lead to glare which is very uncomfortable for workers and can reduce their productivity. (cf. Alhorr et al. 2016 pp.27)

Due to the case study all offices are located along the facade where windows are implemented. Open windows provide fresh air and the light can go through the glass. The rearrangement of some offices can eliminate glare. According to the research all occupants are very satisfied to sit close to windows which provide natural lighting. The employee which is working on the first floor complained that he is getting less light and would prefer more for a better performance. This means, that in the literature and the survey agree with each other.

10.5. Noise

Literature highlights, that there is a link between the productivity of employees and the indoor sound level. The indoor sound level also depends on the noise from outside, which should be kept to a minimum by installing proper isolation. The internal acoustic can be disturbed by many factors such es employees, telephones or other technical equipment. It always depends on the tasks, which office type is the right for an organization. However, disturbance through noise is a very serious topic and should be considered. Different design elements have the feature to absorb noise too keep the noise level low. (cf. Alhorr et al. 2016 pp.28)

The survey indicates that acoustic disturbance is important and can lead to a loss of productivity. The employees in cell offices with less than three people are satisfied by their noise level. The only exception is the not isolated walls between the offices. Workers who work together with three or more people in an office complain about noise distractions. Phone calls and talks to other colleagues makes them less productive. An Example is that they can't concentrate and understand 100% of the phone calls.

10.6. Social interactions

Communication is a central component of management. Cooperation with partners, customers and other external firms would be impossible without communication. The internal communication is also very important. (cf. Ansgar Zerfaß et al. 2014 pp. 2)

The contact between the respondents and their colleagues takes mainly place in the offices or at the workplace. According to Brookes and Kaplan (1972, pp. 373) most of the contact takes place in the corridors. The survey which was done, does not agree with it because the employees, which were asked never talk in the corridor because of privacy issues. The statements of the asked persons show a clear trend, that the

satisfaction is higher when they have the possibility to work silent in a close room. This has the advantage, that the employees do not fell supervised the whole day. Windlinger und Zäch (2007, pp. 77) describe, fast and easy communication increases the social cohesion. It is proven, that employees communicate most of the time with colleagues who work on the same floor or close to their offices. (cf. Brookes und Kaplan 1972, pp. 373)

The case study points out, that individual offices or offices with less than three people are perfect for doing their work. As a result, the tested persons feel more satisfied to work individually and at the same time to have communication areas for business meetings. (Lee und Brand 2005, pp. 323.) On the one hand, tenants who work in group offices enjoy the possibility to talk during their work with other employees, which increases the speed of communication. On the other hand, they suffer from the not provided separation. Therefore, communication areas should be provided. There is also the possibility to book meeting rooms. These aspects are pointed out by Sundstrom et al. (1982, pp. 379)

The findings of Brennan et al. (2002, pp. 279), according to which communication in open space concepts generally increases is proven by the survey, but not that less meeting rooms are needed. The author sees the reason for that, because most of the employees work in in cell offices and not in group offices.

In this case, the smaller offices increase the social contact because too less communication areas are provided which makes the workers to meet in the offices. From the results of the interviews it can be concluded, that individual offices can also promote communication through appropriate design.

In summary, for the category of social interaction, similarities between the results of the case study exist. The case study clearly shows, that proper design of working spaces can increase the communication. For improving communication spatial communication areas need to be close to the office. Combining communication and individual work will lead to an increase of satisfaction (cf. Jacquemin 2010, pp. 66) Furthermore, it cannot be excluded, that the differences between the case study and the literature are caused by routines and the company's culture.

10.7. Privacy

The private and public spheres have been inextricably linked for centuries: The private sphere is a space of individual retreat and at the same time an indispensable prerequisite for the free formation of opinion. (Schaar 2009 pp.19) The case study shows that there is a correlation between privacy and efficiency. Most of the asked persons describe visual privacy as very important. Both visual privacy and acoustic privacy is rated as crucial. Satisfaction with acoustic privacy depends on how the office concept supports respondents in their work. The results of the interviews indicate, that the acoustic privacy seems to be important to the employees because of private talk to other employees or phone calls. The majority of respondents have an individual office or an office which is shared by three or less colleagues. Less occupants in an office offers acoustic privacy and fulfils its purpose regarding the execution of work tasks. The case study indicates, that occupants in group offices with less acoustic privacy leads to a loss in communication. As a result, the employees are less satisfied and productive.

The visual privacy case study shows, that it plays an important role for the employees themselves and their work. It is a requirement for the workers to be able to do most of their tasks individually, because confidential data is just intended for them. The research highlighted that visual privacy is more important than acoustic privacy for them. In this aspect the literature does not correspond with the survey. Brennan et al. (2002, pp. 279) think, that visual privacy is not as important as acoustic privacy. Regarding to privacy and density at the workplace, the case study shows that respondents prefer a lower density which leads to a higher level of privacy. Accordingly, the findings of Oldham (1988, pp. 253) coincide with the results of the case study.

The author and the questioned employees suggest that the cell offices are the best solution for their work tasks. For improving communication, proper communication areas should be created. Combining a closed structure of offices with a welcoming area for informal talks and meetings would be a great solution for increasing the workers productivity. At the same time the current status would be kept high.

11.   Conclusion

This study mentioned a broad range of different literature available, which shows the link between the design of an office, the occupant's comfort and the resulting satisfaction and productivity gain and loss.
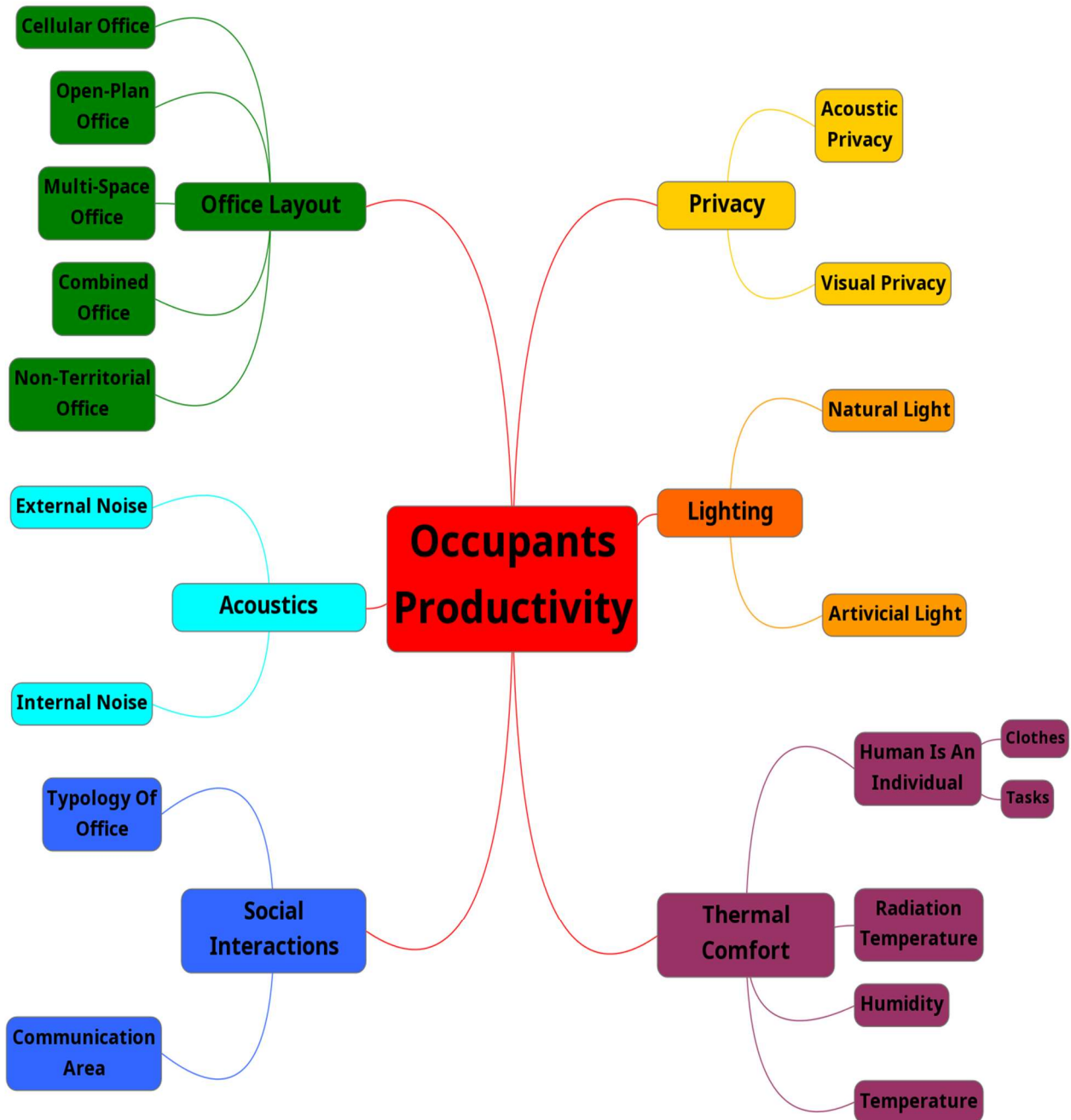

Figure 26 Influences on occupants' productivity (own figure)

Literature highlights, that occupant's productivity depend on physical and social factors. First, the physical factors will be discussed. Acoustics, office layout, lighting and thermal comfort have the most significant impact on the employee's performance. Also, the physical factors correspond with each other. For example, the lighting has an impact on the thermal comfort as well the office layout on the acoustics. To improve the occupant's satisfaction and even productivity every single aspect needs to be explored deeply. Different authors describe the achieving of gaining productivity as a very difficult task. Occupants comfort is a very complex topic with a lot of different approaches. The comfort level of employees relies on the physical factors. The whole office environment creates a comfortable or uncomfortable zone. Every human is different and if it is comfortable for one person doesn't it mean that it is comfortable for the other. Every task has a different optimum comfort level. This shows the complexity of comfort within a company. Different standards from different countries around the globe recommend different indoor parameters. This is a good starting point, but not the optimum for everyone. Therefore, occupants' comfort is highly subjective and depend on many different individual factors. These factors are for instance: age, gender, cloths, metabolism, activity, location and many more. New technologies such as Building information modeling, cloud services, remote controlling, big data analyzes, and sensors may help to achieve certain goals. These inventions are very helpful in modern buildings. On the one side it can increase the occupant's satisfaction on the other helps to reduce energy and maintenance costs.

This state-of-the-art paper is a detailed analysis of the physical environment and its impact on the employees. It combines literature from various fields and a survey which was done by the author.

Social interactions are part of every company. Not everybody is working alone, teamwork is something very necessary in nowadays businesses. Therefore, communication is the most important tool to work together efficiently. Faster communication is increasing the productivity but at the same time privacy shouldn't be disturbed. Therefore, a mix of communication areas and spaces for individual work should be provided. The positive effect of privacy in the office on job satisfaction was also demonstrated in the case study. The study and literature correspond in most of the

points and show, that privacy in an office building is important for the employees' satisfaction.

The aim is to make it understandable, that there are two sides, one is the user and one is the owner of the building owner or company. At the end both should have improvements. To reach a gain in productivity engineers and architects, and especially the facility management should be designing a proper fitting design for occupants to reach that goal.

11.1. Relevance

This paper should highlight that the office building by itself has an impact on the employee's satisfaction and productivity. It is indispensable to make workers feel comfortable within the company to ensure their long-term success. For firms it is very important to understand that satisfied workers are more productive and generate better results. The findings of this study should show company owners, managers...etc., the significance of a proper office design and its influences.

11.2. Reflection of the paper

At the beginning of the paper the author was concerned of the literature research. Luckily for this topic already different studies were done, and a lot of literature was found in local libraries and in the internet. After establishing a literature list with the most important books and articles, the author focused on writing the theoretical part of the paper. The intensive study of literature was indispensable to start with the empirical study. To find appropriate interview partners was harder than assumed. Some employees were frightened that the data of the interview will be published and that this will have a negative impact on their work. At the end nine employees were

willing to do the interviews. The author tried to make the interviews as comfortable as possible. The interviewees were always separated to another part of an office building where nobody could listen to their answers. This was important to provide acoustic and visual privacy. The test persons should have felt, that they are in a safe environment where they can talk freely about the advantages and disadvantages of their workplace. With regard to the composition of the sample, the fact that there is no absolute balance between women and men should be considered. The semi unstructured interview was the best choice for doing the interviewees. Talking about their workplace is not an easy topic and a completely structured interview would have been not possible. Every employee has his own opinion and most of them are sitting in different office types. The test persons described topics in different ways and added verbally new chapters to the interview. However, the pretest was a challenge for the researcher to understand the test person, because of the lack of experience. The pretest was very helpful for the author to get used to the interview situation. The next step was the transcription which took a lot of time. For the qualitative content analysis, the method of Mayring was chosen. This was the appropriate solution for structuring and defining the most essential parts of the interview answers. However, the categorizing of the answers was challenging. Some answers were related to more than one category, which made it even harder. The author still thinks that some categories are related to each other. To avoid wrong interpretations and to ensure that the explanations of the interviewees are related to satisfaction and productivity the researcher controlled the transcriptions. After the results of the survey the author described different variants of how this office building could be improved. Visualizations to get a deeper insight of the building were established. Also, the wishes of the employees were observed. To sum up the discussed topic is very important for companies to ensure a longer profit.

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Interview Questions (German)

Allgemeines

Ziel des Interviews ist es, herauszufinden, welche Anforderungen an die Büroräumlichkeiten und die Funktionalitäten gestellt werden. Zudem geht es darum, für die Optimierung des Arbeitsplatzkonzeptes die notwendigen Vorgaben zu ermitteln um anschließend die Planung realisieren zu können. **Diese Daten werden anonym für das schreiben einer Masterarbeit verwendet.**

Interviewpartner:	
Unternehmen:	
Unternehmensbereich/ Abteilung:	
Anzahl Mitarbeiter in der Abteilung:	
Haupttätigkeit der Mitarbeiter: (in der Abteilung/persönlich)	
Geschätzter Anteil Außendienst in %: VZ/TZ	
Datum des Interviews:	

Leitfaden des Interviews

Fragestellung	Diskussionsergebnis
Altersspanne	☐ < 25 Jahre ☐ 25 – 34 Jahre ☐ 35 – 44 Jahre ☐ 45 – 54 Jahre ☐ > 55 Jahre
Geschlecht:	☐ W ☐ M
Bürokonzept:	

Ist eine persönliche Anpassung des Arbeitsplatzes möglich?	
Wurden individuelle Anpassungen im Büro vorgenommen? Wenn Ja welche?	
Wirkt sich ein personalisierter Arbeitsplatz auf ihre Leistung und Zufriedenheit aus?	
Sind Sie mit dem Grundriss zufrieden? Gibt es Verbesserungsmöglichkeiten?	
Sind sie mit den Technischen Einrichtungen im Büro zufrieden?	
Sollte sich an der Ausstattung ihres Arbeitsplatzes etwas ändern?	
Wie empfinden sie die Geräusch- und Lärmbelastung?	
Wie sind die Lichtverhältnisse für sie? Bevorzugen sie natürliches oder künstliches Licht?	
Wie empfinden sie die Temperatur in ihrem Büro?	
Ist die Ergometrie der Möblierung für sie passend?	
Gibt es andere Störfaktoren?	

Wie empfinden sie den sozialen Zusammenhalt in ihrer Abteilung?	
Ist die Nähe ihrer Mitarbeiter wichtig?	
Wie findet die Kommunikation zu ihren Mitarbeitern statt?	
Wo findet informelle Kommunikation statt? Ist ihnen diese wichtig?	
Anteil (in %) an Besprechungen pro Tag? Pro Woche? Wo finden diese statt?	
Ist ihnen Privatsphäre im Büro wichtig (akustisch, visuell)? Hat diese Auswirkungen auf ihr Wohlbefinden und Produktivität?	
Wäre Desk-Sharing möglich? Wenn Nein warum nicht?	
Gibt es Planungsempfehlungen?	
Gesamtnote des Büros? 1-5 1 Sehr gut, 5 nicht genügend	

Offene Diskussion

Wo gibt es derzeit Problemzonen? Was muss auf jeden Fall anders werden?

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_____

_____

_____

Was hat sich bewährt und soll keinesfalls anders werden?

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_____

_____

_____

Sonstiges?

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_____

_____

_____