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Table of Contents

List of Figures.....	4
List of Tables.....	6
1 Introduction	7
2 Literature Review	10
2.1 The Open-Plan Office Concept	10
2.2 Why Are Open-Plan Offices Used by Employers?.....	12
2.3 Effect of Office Type on Health and Well-Being	14
2.4 Workplace Satisfaction and Relevant Factors	15
2.4.1 Workplace Satisfaction	15
2.4.2 Relevant Factors	17
2.4.2.1 Noise	17
2.4.2.2 Privacy	22
2.4.2.3 Measures for Improvement of Privacy	23
2.5 Deriving the Hypotheses	24
2.5.1 Hypothesis 1 - Workplace Satisfaction Compared to Previous Research Results.....	24
2.5.2 Hypothesis 2 - Workplace Satisfaction is Depending on the Previous Working Experience Further Influenced by the Age of Employees	24
2.5.3 Hypothesis 3 - Differing Satisfaction Levels in Separate Working Areas.....	25
2.5.4 Hypothesis 4 - Impact of the Amount of Working Hours.....	26
2.5.5 Hypothesis 5 - Impact of cognitively demanding tasks on noise satisfaction level and task performance.....	26
2.5.6 Hypothesis 6 - Shortage of Available Workstations Increases Dissatisfaction.....	26
3 Data Collection	28
3.1 Questionnaire Design	28
3.2 Questionnaire Distribution	29
3.3 Selected Companies.....	29
4 Empirical Part	31
4.1 Data Overview and Descriptive Statistics	32

4.1.1 Part One – Personal Information	32
4.1.2 Part Two – Workplace Satisfaction	36
4.1.3 Part Three – Open-Plan Specific Factors	40
4.2 Testing of Hypotheses and Statistical Analysis	43
4.2.1 Preparation of Data for Statistical Analysis	43
4.2.2 Hypothesis 1 – Workplace Satisfaction Compared to Previous Research Results	45
4.2.3 Hypothesis 2 – Workplace Satisfaction is Depending on the Previous Working Experience Further Influenced by the Age of Employees	49
4.2.4 Hypothesis 3 – Differing Satisfaction Levels in Separate Working Areas	53
4.2.5 Hypothesis 4 – Impact of the Amount of Working Hours	63
4.2.6 Hypothesis 5 – Impact of cognitively demanding tasks on noise satisfaction level and task performance.....	66
4.2.7 Hypothesis 6 – Shortage of Available Workstations Increases Dissatisfaction	69
4.3 Improvements for Already Existing Open-Plan Offices and Enhancing the Designing Process of such Environments.....	73
4.3.1 Noise-related Improvements.....	74
4.3.2 Privacy-related and Technological Improvements.....	76
5 Conclusion	78
6 Sources	80
7 Annex.....	84
7.1 Abstract	84
7.2 Zusammenfassung	84
7.3 Questionnaire	85
7.4 Other Tables	88
7.4.1 Complete list of p-values for all items (in chronological order) from part two and part three of the questionnaire to compare values between home bases (p-values under 0.05 are highlighted).....	88

List of Figures

Figure 1: Age Distribution in Questionnaire.....	32
Figure 2: Job Position Distribution in Questionnaire	33
Figure 3: Working Hours in Questionnaire.....	34
Figure 4: Number of Employees in Departments in Questionnaire	35
Figure 5: Mean Workplace Satisfaction	37
Figure 6: Items with the highest amount of dissatisfied employees	38
Figure 7: Items with the highest amount of satisfied employees.....	39
Figure 8: Average overall satisfaction level of employees without previous working experience in more private office forms and employees with such experience.....	49
Figure 9: Percentage of dissatisfied, neutral and satisfied employees for the three groups: no experience with private offices, employees who have this experience and prefer or don't prefer open-plan offices	50
Figure 10: Comparison of different items throughout the three age groups (neutral opinions towards the preference of open-plan or private/cell offices have been left out of the graph)	51
Figure 11: Percentage of employees who agree with the item "I often overhear other colleagues talking due to the office layout", percentage of employees who disagree and the arithmetic mean (neutral answers not depicted)	55
Figure 12: Percentage of employees who agree with the item "I take the opportunity to do home office once a month or more often", percentage of employees who disagree and the arithmetic mean	57
Figure 13: Percentage of employees who agree with the item "When I come in the morning, there are a lot of different workplaces available that I can choose to work at", percentage of employees who disagree and the arithmetic mean	59
Figure 14: Percentage of employees who agree with the item "I feel that I can be more creative in an open office configuration", percentage of employees who disagree and the arithmetic mean	61
Figure 15: Average satisfaction levels for employees, differentiated by their working hours into part-time and full-time employees (neutral answers as well as not stated ones have been left out of the graph)	64
Figure 16: Correlation matrix between simple/cognitive demanding tasks and all other noise- related items in the questionnaire	66
Figure 17: Satisfaction level for the rotation of the workplace, taking the employees' agreement or disagreement with related items in the questionnaire into account .	70

Figure 18: Percentage of employees who agree or disagree with items regarding possible improvements in open-plan office environments	74
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List of Tables

Table 1: Average Item Ratings	42
Table 2: Correlation matrix of the 16 independent variables concerning workplace satisfaction	45
Table 3: Complete linear regression model of second part of questionnaire (workplace satisfaction)	46
Table 4: Variance inflation factor for independent variables in the linear regression model ..	47
Table 5: Reduced Model through Stepwise Selection (AIC).....	48
Table 6: P-values for comparison of overall satisfaction between all available home bases .	53
Table 7: P-values regarding the comparison of the questionnaire item "I often overhear other colleagues talking due to the office layout" between departments.....	54
Table 8: P-value for Mann-Whitney-U-Test, comparing the ratings of the item "I take the opportunity to do home office once a month or more often" between working areas	56
Table 9: P-value for Mann-Whitney-U-Test, comparing the ratings of the item "When I come in the morning, there are a lot of different workplaces available that I can choose to work at" between working areas	58
Table 10: P-value for Mann-Whitney-U-Test, comparing the ratings of the item "I feel that I can be more creative in an open office configuration" between working areas	60
Table 11: P-values for Mann-Whitney-U-Test between part-time and full-time employees concerning all satisfaction items from part one of the questionnaire	63
Table 12: Linear Regression model via AIC selection algorithm with noise satisfaction as dependent variable.....	67
Table 13: Correlation matrix for the above-mentioned items.....	72
Table 14: Linear regression model for satisfaction with workplace rotation as dependent and relevant items as independent variables	72

1 Introduction

Open-plan offices enjoy great attention by organizations which aspire to keep pace with the times and provide a modern workplace for their employees. Therefore, it seems almost natural when a new office building is constructed nowadays that it is conceptualized as a creativity-enhancing, communication-improving and team-friendly workspace, also known as the open-plan office environment.

Since open-plan offices are quite widespread nowadays and employers put the emphasis mainly on the many advantages of this office concept, I will take a critical look at this topic in my thesis. I will evaluate the most relevant factors which have an impact on the employees working in such an office environment and moreover their well-being and satisfaction. This thesis aims at an all-embracing picture of open-plan offices and therefore the advantages as well as the downsides are critically and objectively evaluated. When reviewing the existing literature, I find that it usually focuses on one aspect of open-plan offices in detail, whereas I aspire to connect the literature, as well as enhance it with my own findings from the empirical analysis, to receive a complete picture of the influence factors on employee satisfaction in an open-plan working environment. I want to elaborate on various factors, which have the largest positive and negative impact on employees in their working environment according to literature as well as looking into new aspects, like the rotation of the workplace, which are not mentioned in research yet. A literature review of the existing research in this area therefore serves as a basis of future analysis in my thesis and answers my first research question, which is formulated as: **What factors mainly influence employee workplace satisfaction and well-being in open-plan office environments and how do they impact the employees' task performance?** One will see that the perception and existence of privacy and noise plays an important role in employee satisfaction. Next to privacy, noise is a more complex topic which has different impacts on employees depending on the kind of noise and the type of tasks employees have to perform.

Later in the thesis, these basic findings are further enhanced and supported by an intensive analysis of data obtained from conducting a questionnaire in companies with this open-plan office setting. Through this analysis the following research question is answered: **Are employees satisfied with the open-plan office environment with**

respect to the reviewed factors for workplace satisfaction and overall satisfaction? This research question is already partially covered by e.g. Bodin Danielsson and Bodin (2008) or Kim and de Dear (2013). Nevertheless, this topic is interesting to cover once more, since the office buildings of the companies where I conduct my questionnaires were erected in 2016 or later. Therefore, known issues for open-plan environments could have already been considered and taken into account when designing the new offices, possibly leading to different results than those stated in existing research. Research question 2 cannot be generally answered with a simple yes or no. By testing various hypotheses in later chapters, it becomes clear that workplace satisfaction is not an objective measure that can be viewed without any further distinctions and restrictions. Workplace satisfaction is therefore not only depending on factors which can be controlled by the office environment but is also impacted by other factors such as age, gender and working hours. Also, the different offices within a company cannot be seen as homogeneous objects, which is displayed by the differences in workplace satisfaction between employees located in different home bases. The workplace satisfaction is therefore a very complex construct which is also depending on factors outside the scope and control of an employer, which makes it more difficult to ensure employee satisfaction as an organization.

The third research question focuses on dependencies between certain characteristics in open-plan environments and their impact on satisfaction levels. Research question 3 is formulated as: **How do certain shortcomings in open-plan office configurations affect employees in their workplace satisfaction?** This research question is again addressed by various hypotheses in Chapter 4. Certain situations, such as the shortage of available workstations have not been covered in existing research yet and are therefore interesting to be analyzed in relation to different satisfaction types. While evaluating this research question it becomes immanent that certain factors, such as noise, are particularly depending on the subjective perception of the employees and therefore cannot be measured or described in a predefined way, which makes a generalized conclusion nearly impossible. There must be rather a distinction made between certain groups of employees according to their perception and preferences of different factors and impacts.

The fourth and last research question is formulated as follows: **What improvements can be made in existing open-plan environments or for future open-plan environments to enhance employee satisfaction?** This research question has only been directly addressed in existing research concerning the improvement of speech privacy in open-plan office environments by Sarwono et al. (2015). Therefore, with research question 4, I openly address improvements which can be made in open-plan office environments concerning various factors, which will enhance employee satisfaction and overall job quality. The possible improvements are derived from the employees' answers to certain questionnaire items as well as conclusions taken from hypotheses which are being tested in my thesis.

Besides answering the above-addressed research questions, the main purpose of my thesis is to give a well-rounded picture of open-plan office environments and depicting its effects on employees. My work delivers on one side an added value to research in this field by gaining new insights into workplace satisfaction and the corresponding factors by which the employees' satisfaction in the office environment is influenced. These findings are moreover presumed to serve as a starting point for further research towards this employee-oriented direction.

On the other hand, practical insights, gained via thorough analysis of the data provided by the employees, are relevant for employers as well as for employees in their professional life. Concerning this aspect, my thesis could provide some form of guidance in real-life working conditions for organizations who plan on introducing an open-plan office environment or improving said workplace to ensure a sufficient level of employee satisfaction. Moreover, employees themselves can benefit from these insights, by becoming more aware of critical issues in open-plan office environments and therefore being able to pro-actively reacting to disturbing factors in a proper way, consequently achieving a higher satisfaction level in the workplace.

2 Literature Review

By relying on existing research in different relevant fields, the literature review gives an overview of open-plan office constructs, why they are being used by organizations this often and how this office environment affects employees in their task performance, well-being and workplace satisfaction. Also, the most critical factors which need to be considered therefore and how conditions can be improved to best fit employees' needs are pointed out.

2.1 The Open-Plan Office Concept

In the 1960's two German management consultants, Eberhard and Wolfgang Schelle, developed a theory of open-plan design known as "Bürolandschaft" or landscape office. The open-plan office concepts we know nowadays are based on this so-called Quickborner concept, which focuses on the improvement of communication and workflow between employees through the removal of internal walls (Pile, 1976). The main characteristics of open-plan concepts are the utilization of a single spacious room (Sarwono et al., 2015) and the absence of floor-to-ceiling walls, which, from there, led to a variety of different concepts. The only minor barriers in use to separate individual workstations from each other are partitions, screens, shelves, various office equipment or plants (Zalesny and Farace, 1987).

Open-plan offices can furthermore be divided into three sub-groups using the number of people sharing the same workspace as distinction criteria (Bodin Danielsson and Bodin, 2008):

- A **small open-plan office** consists of four to nine people in the workspace and is conceptualized on the basis of group psychological theories to enhance group identity due to the smaller group size (Svedberg, 1992). It is often likely that the supervisor is located at the same office area as the other employees, which is not always the case in larger variations of open-plan office configurations.
- A **medium open-plan office** offers space for ten to 24 employees and is the most common office type in Sweden.
- Large **open-plan offices** have room for more than 24 people and are often used in the U.S.

An additional office type worth mentioning due to the relevance for the empirical part of my thesis is the **flex office**, which is usually an open-plan office, but with the main distinction that no employee has their own individual workplace and everyone can choose a spot that best meets their needs for the current tasks. Flex offices have gained popularity in the 1990's, because they save a significant amount of office space. A distinct feature of the flex office is the provision of focus areas and backup spaces, which enable the employees to have private phone calls, meetings and retract for tasks that demand more concentration. Concerning the design of flex offices, the assumption is made that less than seventy percent of the workforce are simultaneously present in the office at all times, relying on expected sick-leaves and work outside of the office, such as home office or customer appointments. Therefore, the space provided in the office area will only offer space for seventy percent of the workforce due to above-stated assumptions (Bodin Danielsson and Bodin, 2008). This planned shortage of office space might lead to an increase in the dissatisfaction level of employees, if more employees than expected are present in the office environment and thus are not able to find a suitable workstation to conduct their daily tasks.

2.2 Why Are Open-Plan Offices Used by Employers?

An important part of every organization is having motivated and efficient employees, which will ultimately result in generating higher profits. The office environment and the physical setting can be seen as important tools for improving the interaction between employees and work efficiency (Becker, 1982). One of the biggest challenges of an organization is to provide an environment that best supports the tasks which are performed by the employees (Nickerson, 1995).

Open-plan offices are believed to improve beneficial communication between employees, the flow of ideas (Zahn, 1991), the ease of interaction and team work through the removal of internal walls, whereby organizational productivity and work performance are also improved (Brand and Smith, 2005; Kupritz, 2003), although research shows mixed results concerning this matter (De Croon, Sluiter, Kuijer and Frings-Dresen, 2005). According to a very recent study by Bernstein and Turban (2018) even quite the opposite effect might be the case. Face-to-face communication goes down by seventy percent, while communication through electronic devices, like e-mail and instant messaging rises, when transitioning from enclosed offices to open-plan offices. Therefore, an open-plan office environment leads to employees' social withdrawal from co-workers rather than enhancing the face-to-face communication (Bernstein and Turban, 2018), which is also in line with the dominant opinion of previous research, which suggests that the disadvantages of open-plan office environments prevail (Kim and de Dear, 2013).

A reason why improved communication in open-plan offices might not be supported by studies, could be that interactions with colleagues are a distraction from tasks and have an immediate negative effect on performance. The added value of those interactions to which organizations are referring to might only show in the long run, which is harder to identify (Seddigh et al., 2015). Supporting this theory of improved communication in open-plan offices, Kim and de Dear (2013) indicate that the improved ease of interaction between co-workers might be overshadowed by the penalties of an increased noise level and the privacy decrease in open-plan environments.

Other important reasons for organizations to choose an open-plan office setting are the immediate tangible economic benefits that arise, such as an increased occupant density, a better utilization of the office space and the possibility to easily rearrange

the working area in the future (Duffy, 1992; Hedge, 1982). Also, the fact that workspace costs are the second largest financial overhead for an organization (McCoy, 2005) and cost savings through the introduction of open-plan offices are estimated to be around twenty percent (Davis, Leach and Clegg, 2011), constitutes a big argument for this type of office setting. Before-mentioned cost savings specifically arise from lower costs in construction and maintenance as well as energy savings for air conditioning and lighting, which might influence the employer's choice of the workplace setting significantly towards open-plan constructs (Sarwono et al., 2015; Seddigh et al., 2015).

2.3 Effect of Office Type on Health and Well-Being

Health and well-being possess a high degree of importance in the working environment nowadays when looking at the emphasis that is put on a flexible working schedule as well as on a leveled work-life-balance by employers and employees. Therefore, it is important to recognize the influence of the building environment of an organization and its workplace architecture on the employees' health and well-being (Evans and McCoy, 1998).

Bodin Danielsson and Bodin (2008) show that the nature of the office type effects health and well-being and moreover that the worst effects on employees occur in open-plan office environments, while better overall health is associated with cell offices, which offer space for only one employee. Specifically, the lowest health status can be found in small and medium-sized open-plan offices, where the majority of employees self-report that their overall health status is "not very good". This finding may stem from the lack of backup space provided in the smaller versions of open-plan office configurations. Therefore, employees do not have the possibility to retract somewhere to attain privacy for work-related or personal reasons, which moreover may affect their overall health (Bodin Danielsson and Bodin, 2008).

Small and large open-plan offices are inferior to other office types concerning mental health, according to the high relative number of physical and psychological problems reported, which are to such an extent where they interfere with the employees' social and personal life. Also, the highest proportion of sad and depressed employees can be found in small open-plan offices, which aligns with the previous statement about employees' psychological health (Bodin Danielsson and Bodin, 2008). Various research confirms the findings by Bodin Danielsson and Bodin (2008) by suggesting that health issues such as headache, tiredness, distress, irritability, concentration difficulties and respiratory infections, are closely linked to open-plan office layouts and therefore might explain the high sick-leave numbers and overall low self-reported general health status by employees in open-plan office layouts (e.g. Pejtersen, Allermann, Kristensen and Poulsen, 2006; Hedge, 1984; Klitzman and Stellman, 1989).

2.4 Workplace Satisfaction and Relevant Factors

2.4.1 Workplace Satisfaction

Workplace satisfaction can be defined as a “pleasurable or positive emotional state, resulting from the appraisal of one’s job experiences” (Locke, 1976, p. 1300) and plays a crucial role in attaining motivated and well-performing employees (Bodin Danielsson and Bodin, 2008).

Research shows that the office type correlates with job satisfaction amongst employees, but also other factors such as age, gender and job position are important influence factors (Bodin Danielsson and Bodin, 2008). Nevertheless, open-plan office environments generally yield a lower score concerning workplace satisfaction than more enclosed office types, whereas employees who work in configurations with no or only limited partitions tend to be more satisfied than those who work in cubicle-like environments (Kim and de Dear, 2013). Sundstrom, Herbert and Brown (1982) demonstrate in their longitudinal survey that relocating employees from an enclosed workspace to an open-plan office setting leads to a decline in overall workplace satisfaction and a negative perception of the office environment.

Kim and de Dear (2013) support the above-mentioned view that enclosed office layouts clearly outperform open-plan environments concerning workplace satisfaction by showing that enclosed private offices yield the highest overall workplace satisfaction in comparison to other office types. Different sizes and configurations of open-plan offices show similar average scores concerning workplace satisfaction, below those of enclosed office types (Kim and de Dear, 2013). The lowest satisfaction level can be found in medium-sized open-plan offices according to Bodin Danielsson and Bodin (2008). The reason for this finding could be rooted in the size of the office space. Accommodating ten to 24 employees might be too many for the employees to get to know each other and therefore improve team efficiency and yet too small to form meaningful subgroups (Lenéer-Axelsson and Thylefors, 1991; Svedberg, 1992). The factors which contribute most to the ascertainment that open-plan office environments yield a lower workplace satisfaction are related to sound and visual privacy, acoustics, temperature and proxemic issues, which are rated better by employees in private, enclosed offices than by the ones working in open-plan configurations (Kim and de Dear, 2013). The main contributors to workplace dissatisfaction in open-plan office

layouts are hereby noise and insufficient privacy (e.g. Bodin Danielsson and Bodin, 2009; de Croon et al., 2005), which will be described in detail in later chapters.

There are also factors to be taken into account, which positively influence the well-being of employees in open-plan office environments. Workplace satisfaction is assumed to increase with the improved communication inside teams through the absence of internal walls in open-plan office configurations, which still needs to be scientifically verified (Kim and de Dear, 2013). Nevertheless, the data analyzed by Kim and de Dear (2013) doesn't support this assumption since the ease of interaction was not rated better in open-plan office environments than in enclosed office spaces.

The need for personal control over the physical workspace, for example creating an individualized workplace or closing the door when privacy is needed, also plays an important role in how satisfied employees are. Open-plan office constructs usually do not suffice in this context, while cell offices provide employees with more independence and the power to exert personal control through their organizational features, which then leads to a higher workplace satisfaction (Lee and Brand, 2005; Bodin Danielsson and Bodin, 2008). Flex offices score high concerning health status and overall workplace satisfaction, which indicates that personal control is applied in this office setting through the possibility of choosing a workplace freely and therefore satisfies the employee even without having personalized workstations (Bodin Danielsson and Bodin, 2008).

2.4.2 Relevant Factors

As mentioned in chapter 2.4.1 Workplace Satisfaction, there is a variety of factors which impact employees in their well-being and job satisfaction. The most impairing components are noise and the lack of visual and sound privacy, which are therefore described in more detail in the following chapters. Other factors that define working in an office environment as well, such as temperature, lighting or air quality, are not mentioned further in my thesis. This is due to the lack of relevance of said factors in the context of employee workplace satisfaction and well-being as portrayed by Kim and de Dear (2013). Also, research towards these topics in combination with open-plan office constructs mainly focuses on the energy-saving perspective and potential of before-mentioned factors, which is outside the scope of my thesis.

2.4.2.1 Noise

A study by Seddigh et al. (2015) shows that noise has a negative effect on task performance, especially concerning tasks which require a high cognitive capacity from the person who is performing the task. The noise effect is higher in larger open-plan offices than in smaller ones, which might stem from a higher prevalence of irrelevant stimuli in larger open-plan settings due to a higher number of employees around (Seddigh et al., 2015). A main source of noise that causes distraction is irrelevant, but still audible speech from co-workers (e.g. Haka et al., 2009). The waste of working time through noise distraction and therefore a loss in productivity is double compared to more enclosed office types and yields a higher effect when tasks, which require a high cognitive capacity, are disturbed (Haapakangas et al., 2008a). According to Evans and Johnson (2000) a decline in task motivation occurs when employees are exposed to uncontrollable noise, such as the type of noise mentioned beforehand, which is more likely to occur in open-plan configurations due to the diminished personal enclosure.

2.4.2.1.1 Irrelevant speech

Employees identified irrelevant speech as the most disturbing source of noise in various studies (e.g. Sundstrom et al., 1994), hence irrelevant speech should be the focus when examining noise in the workplace, over other sources of noise, such as the

sound of a copier or the ringing of telephones. Moreover, irrelevant speech is linked to stress, lower productivity and dissatisfaction with the workplace (e.g. Sundstrom et al., 1994). It also leads to a worse task performance, measured via assessment of the mental workload, compared to performing the same task in quiet conditions and adds to the cognitive workload (Smith-Jackson and Klein, 2009). There are two main theories illustrating the effects of irrelevant speech on task performance:

- The **Irrelevant Speech Effect** states that while conducting a verbal task irrelevant speech is only disruptive if the speech is meaningful to the employee and similar to the stimuli occurring in the performed task (Salame and Baddeley, 1989).
- The **Changing-State Hypothesis** contradicts the irrelevant speech effect by suggesting that not the meaning of speech but any sound that imitates the variations in rhythm occurring in speech prevents the employee from habituating to and therefore ignoring the noise, causing a drop in performance (Jones, 1993).

According to Smith-Jackson and Klein (2009), continuous speech, e.g. two people having a conversation, adds more to the employee workload ratings and leads to a higher decrement in task performance than intermittent speech, which resembles a one-sided conversation, like a person talking on the phone. This finding implies that speech that has a meaning to a person, disturbs him or her more from a task than speech that has no meaning and therefore supporting the Irrelevant Speech Effect theory by Salame and Baddeley (1989). This is furthermore backed by Bridges and Jones (1996), who propose that “word dose”, which is higher in continuous speech, is more important concerning the disturbance of a task than variability.

According to Morris and Jones (1990) employees in open-plan office designs will develop a filter to irrelevant and prolonged speech, which then enhances the task performance, and will moreover undermine the relevance of monitoring such stimuli in the working environment. Nevertheless, this habituation to irrelevant noise will disappear during quiet conditions (Morris and Jones, 1990). This finding is supported by Crawford and Strapp (1994) who discovered that a drop in task performance occurs when students are listening to vocal music. Students who usually study with music are less prone to this drop in task performance than those who prefer a quiet environment

while studying, implying a habituation to irrelevant speech has taken place. Furthermore, Smith-Jackson and Klein (2009) also support this view by finding that a practice effect occurs when being exposed to irrelevant speech.

Also, individual differences concerning noise sensitivity might play a role in the impairment through noise. Weinstein (1974) proposes that sensitivity to noise is affected by one's personality. Belovic and Jakovljevic (2001) later confirm neuroticism as a moderator of the relationship between noise level and subjective noise sensitivity (SNS). Smith-Jackson and Klein (2009) find that low task absorbers, defined so through a questionnaire designed by Smith-Jackson (1998), report a higher workload under noise conditions than high task absorbers, suggesting a different impact of noise due to different personal characteristics.

2.4.2.1.2 Dealing with irrelevant speech

Since irrelevant speech cannot be eliminated entirely in the real world, yet demonstrates one of the biggest distractions from tasks, Smith-Jackson and Klein (2009) provide ways to deal with irrelevant speech in the workplace and minimize its consequences:

- **Skill Acquisition:** Employees must be guided in developing strategies to focus and maintain attention during the presence of irrelevant speech.
- **Gathering feedback:** An organization should be aware of how their employees perceive their immediate working environment and therefore directly counteract the impact of irrelevant speech.
- **Use of noise-minimizing devices:** Interference through irrelevant speech can be kept to a minimum by using tools to reduce noise as well as increase privacy, for example headphones or partitions/barriers serving as acoustical covers. Such devices should be meticulously tested by the organization first to ensure their fitness to the specific workplace.
- **Considerate Behavior:** Employees should be advised to be considerate, e.g. through the implementation of organizational policies, which can include conducting conference calls only in enclosed conference rooms or not using speaker phones in the open-plan area in order to not disturb other co-workers.

2.4.2.1.3 Simple and Demanding Tasks

Zajonc (1965) suggests a different view depending on the type of task. While performing a rather simple task arousal through noise might even enhance, or at least not impair, performance while noise has a negative effect on performance concerning cognitively demanding tasks. Recent studies (Faisal, Selen and Wolpert, 2008; McDonnell and Ward, 2011) support that certain random stimulation can help improve performance for simple tasks. Jackson-Smith and Klein (2009) also found higher completion rates for performing a proof-reading task in surroundings with irrelevant speech than in a quiet environment, explaining this phenomenon with a state of under-arousal, contributing to the research mentioned beforehand.

The explanation for why noise is negatively affecting cognitively demanding tasks can be attributed to different theories. Cohen (1978) suggests that when a cognitive overload takes place, e.g. caused by irrelevant stimuli, the load on the attention resources of a human being are so high that a cognitively demanding task cannot be mastered anymore due to the depleting processing capacity. While Diamond (2013) explains the negative performance effect of noise on cognitively demanding tasks by the concept of executive functions. Executive functions refer to a set of cognitive processes, which demanding tasks rely on, since they are required for concentration and attention. The main functions of these mental processes are to suppress responses and shift the attention between different sets (Diamond, 2013). Therefore, heavily loading those processes by demanding tasks leaves less capacity to successfully suppress irrelevant stimuli, leading to a greater distraction from the task and consequently to a worse performance (Lavie, Hirst, de Fockert and Viding, 2004).

2.4.2.1.4 Comparing different office settings concerning cognitively demanding tasks

Seddigh et al. (2015) conducted a very interesting study, instructing employees to conduct a cognitively demanding task in their usual working environment, and then again in a quiet space. These quiet settings have been artificially created by shutting the door, disabling disruptive factors like e-mail alerts and telephones, muting computer sounds and no talking to anyone while performing the task. As expected, due to the cumulated effect of social interaction and irrelevant stimuli, larger open-plan offices show a greater drop in performance for a cognitively demanding task when

performed in the regular office setting in comparison to a quiet setting than smaller open-plan office environments, which nevertheless also record a small drop. This supports the above-mentioned theories furthermore that there is a negative effect from noise in open-plan offices on cognitively demanding task performance, indicating that the number of people in the working environment is a small and negative predictor for performance. This negative effect is stronger the larger the open-plan office is (Seddigh et al., 2015). Contradicting Seddigh et al.'s (2015) original hypothesis, the performance drop from quiet to normal working conditions is higher for cell offices, comparable to the drop in large open-plan offices, than for medium-sized or small open-plan offices, suggesting that cell offices are not necessarily a better choice for an office configuration than different open-plan office settings concerning noise and performance. This finding can be explained through distractions, which are not related to other colleagues, but technology. For example, the interaction with telephones, e-mail alerts and instant messaging, which is present in any office regardless of the office setup, leads to distractions from the task and therefore to a worse performance. Also, through the high presence of irrelevant stimuli in an open-plan office, an employee might develop certain coping strategies against the before-mentioned irrelevant stimuli. The constant exposure to co-workers social and technological stimuli in an open-plan office might even enhance this coping mechanism further. Also, less distractions might occur in an open-plan office, since co-workers immediately see if their colleague is busy and then eventually delay their interaction. Face-to-face interactions with colleagues might be of value in the long run but cause a loss of efficiency in the short run (Seddigh et al., 2015).

This indicates that organizations, especially knowledge-based ones with many employees, need to pay close attention when choosing an office setting, since even a small drop in task performance might have a significant impact on overall profitability. Considering the effect of noise on performance, choosing a small open-plan office might create an advantage over a larger open-plan office in the long run, although cost savings for the larger type may be tempting for an organization when selecting the office environment (Seddigh et al., 2015).

2.4.2.2 Privacy

There are two different relevant types of privacy concerning the office layout and influencing workplace satisfaction for employees: acoustic and visual privacy. The most important form of acoustic privacy is speech privacy, defined as “the inability to understand conversations” (Lee and Jeon, 2014, p. 307), while visual privacy is impacted by unwanted observation. Both types of privacy therefore experience a significant decline in open-plan office layouts due to the diminished personal enclosure in this kind of office environment, leading to a feeling of loss of personal control over the workspace and privacy (Bodin Danielsson and Bodin, 2009; Brand and Smith, 2005). This loss of privacy due to constant and excessive overstimulation in open-plan office concepts, induced by uncontrolled social interactions and interruptions caused by the close proximity to other co-workers, leads to a negative perception of the office environment according to Maher and von Hippel (2005) and Oldham (1988).

Open-plan offices are especially prone to having an insufficient level of speech privacy (Helenius et al., 2007), stemming from the low partitions between workstations (Sarwono et al., 2015; Haapakangas et al., 2008b), since the partitions alone do not prevent co-workers from overhearing private or work-related conversations.

Good speech privacy means that sounds from a conversation might be audible to other co-workers, but the content of the conversation is not intelligible. Therefore, when designing open-plan office concepts, it is important to ensure adequate speech privacy to the employees in order to maintain a certain level of workplace satisfaction (Lee and Jeon, 2014). Speech privacy can be measured through a ratio that compares the background noise to the speech level (Lee and Jeon, 2014; Cavanaugh et al., 1962). Virjonen et al. (2009) suggest target values, attributable to four different categories, for open-plan office environments to maintain a certain standard of speech privacy.

2.4.2.3 Measures for Improvement of Privacy

Improvement of speech privacy can be achieved through high cost acoustical treatment, which is applied to surfaces, such as spreading the sound evenly through the use of sound diffusers or sound swallowing elements. A better way to improve speech privacy is by re-arranging the office configuration, such as modifying the overall layout, workstation types or partition heights (Sarwono et al., 2015). Rindel (2012) introduces the idea of the use of computer simulation software to analyze open-plan office layouts. This software then provides alternative office configurations with the best speech privacy. Of course, the most efficient way would be to simulate the office layouts already in the construction stage to obtain a design, that provides the desired level of speech privacy at the first go without the need to rearrange it later. Items that can be included in the simulation and changed to improve speech privacy are for example storage units out of different materials, carpets, wall planes or partition heights (Sarwono et al., 2015). Sarwono et al. (2015) show that the highest speech privacy is achieved if partitions surround the workstation on every side and the partition height is 1.5 meters. Contrary to their expectations, by raising the height of partitions the acoustical conditions and moreover speech privacy do not continuously improve (Sarwono et al., 2015).

There is not one ideal open-plan office design, but the layout should depend on the needs of the organization's employees. Individuals working together as a group have different demands for an office layout than employees who deal with confidential information and therefore require a higher level of speech privacy (Sarwono et al., 2015).

2.5 Deriving the Hypotheses

The following hypotheses have been mainly derived from the studied literature as well as from personal experience I gained by working in an open-plan office environment. The main focus of the hypotheses is on influence factors concerning workplace satisfaction and how certain aspects in an open-plan working environment influence each other.

The below-stated hypotheses will then be tested in the empirical part of my thesis, more specifically in the following chapter 4.2 Testing of Hypotheses and Statistical Analysis

2.5.1 Hypothesis 1 - Workplace Satisfaction Compared to Previous Research Results

The first hypothesis aims at confirming that overall workplace satisfaction is mainly influenced and explained by the factors stated in the research paper of Kim and de Dear (2013) and formulated as follows:

H1: The overall workplace satisfaction is mainly affected by the employees' satisfaction with noise, visual privacy, sound privacy and the ease of interaction.

2.5.2 Hypothesis 2 - Workplace Satisfaction is Depending on the Previous Working Experience Further Influenced by the Age of Employees

The second hypothesis suggests that the employees' previous experience with more private office types negatively influences their satisfaction towards open-plan office environments. Therefore, employees with no experience in more secluded office forms are assumed to be more satisfied with the open-plan office environment. If they do not have anything to compare the current working conditions to, it is more likely that they are more satisfied with them than employees who have experience in other office environments as well. In connection to the previous assumption, age plays an important role, because it is more likely that older employees experienced more

different office settings than younger employees. Also, the age of the employees might play a role in the perception of their working environment and therefore also influencing the satisfaction level. H2 is therefore formulated as follows:

H2: Employees with previous experience in more private office settings are less satisfied with the open-plan office layout than the ones without previous experience.

2.5.3 Hypothesis 3 - Differing Satisfaction Levels in Separate Working Areas

The following hypothesis is based on the specific working conditions in the considered companies. As briefly mentioned in chapter 4.1.1 Part One – Personal Information, every employee has his or her designated working area, called a home base. Different teams and departments can be assigned to one home base for example. Therefore, the same clustering of departments, which are located in the same home base, as further mentioned in chapter 4.1.1 Part One – Personal Information, is performed. It is more interesting to look at home bases as secluded working areas than at single departments to identify variations concerning the employees' satisfaction. These differences in workplace satisfaction between different company areas could be caused by various factors, such as desk sharing rates and noise level. Therefore, varying rating results of questionnaire items can be expected, and the following hypothesis is formulated:

H3: There are significant differences concerning relevant factors for open-plan office environments between the single working areas.

2.5.4 Hypothesis 4 - Impact of the Amount of Working Hours

Hypothesis 4 considers the impact of working hours on employee satisfaction. The underlying assumption is that employees who work part-time and therefore spend less time in the office than full-timers are less impacted by negatively perceived factors in open-plan environments. Hypothesis 4 is formulated as follows:

H4: Part-time employees are more satisfied with the open-plan office layout than full-time employees.

2.5.5 Hypothesis 5 - Impact of cognitively demanding tasks on noise satisfaction level and task performance

The following hypothesis 5 is mainly based on the literature research from chapters 2.4.2.1.3 Simple and Demanding Tasks and 2.4.2.1.4 Comparing different office settings concerning cognitively demanding tasks suggesting that employees who conduct tasks which demand a high cognitive capacity, are more prone to surrounding noise and therefore less satisfied with the noise level in the office area. Specifically, irrelevant speech is one of the main negative influencers concerning task performance and efficiency of the employees. Hypothesis 5 is therefore formulated as follows:

H5: Employees who perform mainly cognitively demanding tasks are less satisfied with noise in the workplace and feel more distracted by noise than those who perform simpler tasks.

2.5.6 Hypothesis 6 - Shortage of Available Workstations Increases Dissatisfaction

The following hypothesis is inspired by Figure 6 in chapter 4.1.2 Part Two – Workplace Satisfaction, which depicts that around 20% of the employees are dissatisfied with the principle of rotating workplaces and the concept of no employee having his or her own fixed spot to work at. Hypothesis 6 aims at evaluating the underlying reasons for this finding and is formulated as follows:

H6: Dissatisfaction with the rotation of the workplace is increased, if there is a shortage of workstations in the home base.

3 Data Collection

This chapter describes in detail the questionnaire that has been used for the analysis in the empirical part of my thesis and its distribution as well as the reasoning why the respective companies have been selected.

3.1 Questionnaire Design

The used questionnaire can be found in the Annex under 7.3 Questionnaire. It is divided into three parts. The first part addresses personal information, including age, gender, working hours and job position, to identify possible distinctions in workplace satisfaction within certain social demographic groups.

The second part of the questionnaire was taken from the CBE (Center for the Built Environment) occupant survey database, since this is one of the most used questionnaires concerning post-occupancy evaluation and considered an industry-standard by Kim and de Dear (2013). Another reason why I used this questionnaire is to be able to directly compare my survey results to the results on workplace satisfaction achieved by Kim and de Dear (2013) and moreover support their results, identify deviations and discuss why they might occur. I added one question concerning the rotation of the workplace to the questionnaire since this is relevant in the context of the examined setting.

The third part of the questionnaire addresses open-plan office specific factors that are most relevant according to the literature analysis I have conducted in the first part of my thesis. These factors include mainly noise and privacy, which are identified as the most important influence factors on workplace satisfaction by various researchers (e.g. Kim and de Dear, 2013; Bodin Danielsson and Bodin, 2009; de Croon et al., 2005). I have also drawn from my personal experience of working at a company with only large open-plan offices for two years when designing the items, which are depicted in the questionnaire. I included issues, which I identified as problematic in the context of working in an open-plan office environment to see how these factors were perceived by other employees.

3.2 Questionnaire Distribution

The distribution of the questionnaires has taken place in July 2018 in two companies with offices in Vienna, which are described later in detail in chapter 3.3 Selected Companies. In the first company, I have distributed the questionnaires in analog form, due to the security standards of the organization, which blocked Google Forms in the company network, and I have entered the questionnaires later in Google Forms. From the distributed questionnaires I have received back 88 filled out questionnaires, of which everyone has qualified for analysis purposes. The response rate can be assumed to be close to 100 percent, since I have known most of the employees I have personally approached and asked to fill out the questionnaires. Immediately afterwards I collected the filled-out questionnaires. Therefore, if an employee did not want to fill out a questionnaire, he or she did not receive one in the first place.

For the second organization, only digital distribution has taken place by e-mailing a link, which is leading to the questionnaire on Google Forms, to a number of selected employees via a contact person. 16 employees from the second company filled out the questionnaire online and every filled-out questionnaire could be used for further analysis.

For both ways of distribution, it has been possible to leave empty fields, and therefore employees could have chosen whether to fill out a field or not in case they were not comfortable with answering certain questionnaire items. I have made this decision to allow for empty fields to not lose valuable insights by excluding a whole questionnaire simply because it contains an empty field.

3.3 Selected Companies

For the distribution of the questionnaires, I have selected two companies in the banking sector with offices located in Vienna, which will remain anonymous throughout the context of this thesis. The decision towards these two companies is based on two main reasons: office environment and recency.

- **Office environment:** According to Bodin Danielsson and Bodin (2008) the exact office type under observation here is a large open-plan office since it accommodates more than 24 employees in the office area. More specifically it is a flex office, which is an open-plan office, but with a few more peculiarities, described in detail in 2.1 The Open-Plan Office Concept. The most important being on the one hand that no employee has their fixed workplace, which leads to a rotation of the work station every day. And on the other hand, the great variety of different working zones that is provided, such as focus areas for concentrated work and group tables for project-based work, which has room for around six employees and is therefore best for tasks which require employees to work together closely.
- **Recency:** Both organizations are of great interest for the empirical part of my thesis due to the recency of the erected office buildings in Vienna. One can therefore assume that the latest research concerning open-plan office design has been taken into account when planning these buildings and as a result, problems stated in the literature review section of this thesis might not be of relevance anymore when analyzing data from these two companies. This could explain possible deviations between the existing literature and my analysis. These potential deviations will be looked into further in later chapters.

4 Empirical Part

The aim of the empirical part of my master thesis is to elaborate on the insights gained from the literature review. I am interested in how the relevance of various factors in open-plan office environments is perceived by employees and in what ways they are affected in their work. Moreover, I focus on identifying possible deviations from previous research, which may occur due to the consideration of open-plan office problems by the selected organizations already when designing their new offices. For the evaluation of the before-mentioned focus points, I use quantitative data analysis tools on the distributed questionnaires.

First, an overview of the collected data and the analysis methods is given. Then, the main part follows, consisting of the testing of the hypotheses, which have been derived from the literature, with adequate statistical methods. In the end, appropriate conclusions with suggestions for improvement are drawn from the analysis and possible limitations are shown.

4.1 Data Overview and Descriptive Statistics

To get a first impression of the questionnaire results and create a bigger picture, a general overview and descriptive statistics are presented.

4.1.1 Part One – Personal Information

A total of 104 employees from both companies, whereas one company's share is 85% (company 1) and the others around 15% (company 2), filled out the questionnaire, thereof 34 women, 69 men and one person did not want to specify his or her gender. The age of the employees who filled out the questionnaire ranges from 19 to 58 years, the arithmetic mean being 36 years. Seven employees did not want to identify their age. Details concerning the age distribution are shown in *Figure 1*.

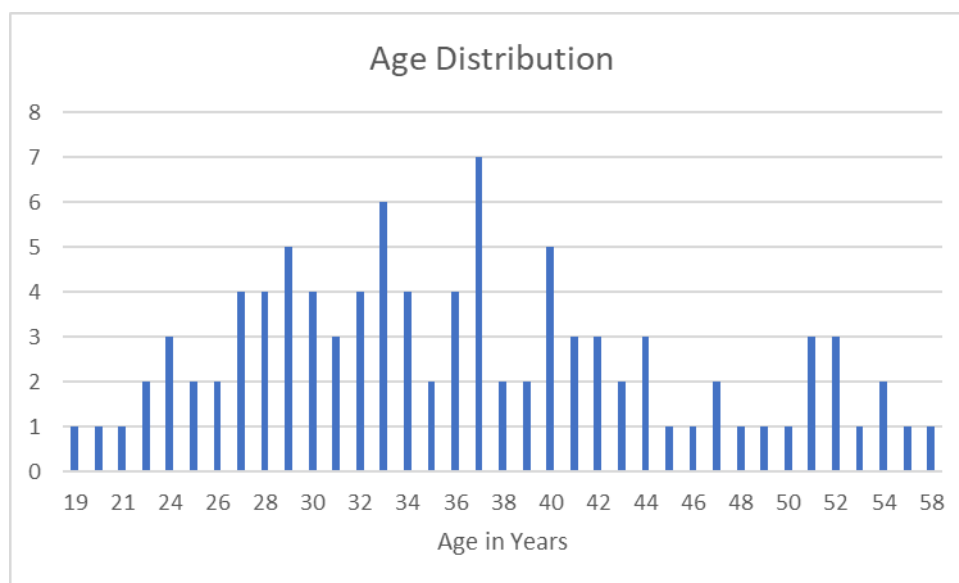


Figure 1: Age Distribution in Questionnaire

The job positions distinguished in the questionnaire are: intern, regular employee, managing position and external or leasing worker. The exact distribution of the job positions can be seen in *Figure 2* below, where it is shown that the vast majority of the questioned employees consist of regular employees with 61%. The item “managing position” includes division managers (B-1), department heads (B-2) as well as team heads (B-3) and therefore yields quite a high share of 15% of the total employees. In

the IT-area a lot of external workers are used, which explains the share of 9% in this category.

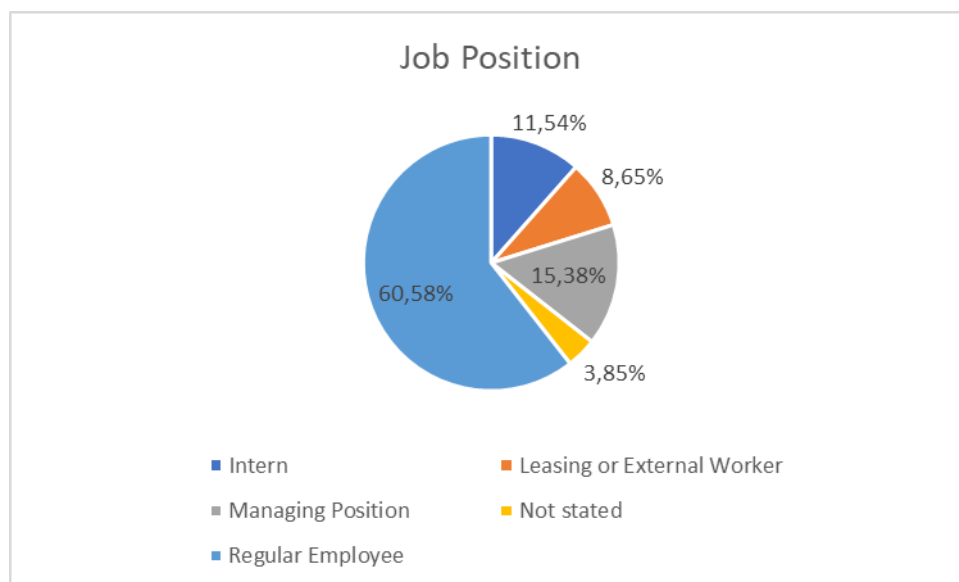


Figure 2: Job Position Distribution in Questionnaire

The working hours are distributed as shown in *Figure 3* below. The majority with 87% are full-time employees. Part-time employees, yielding 10% of the questionnaire population, are almost equally split between regular employees and interns.

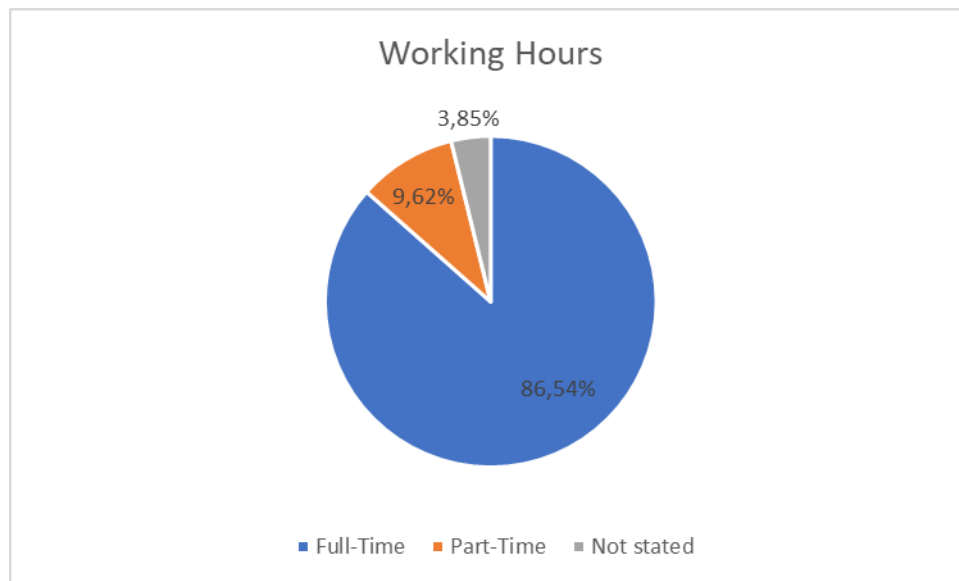


Figure 3: Working Hours in Questionnaire

The questionnaire has been distributed in different departments of the companies, including the areas: Controlling, Enterprise Wide Risk Management (including the departments ICAAP - Internal Capital Adequacy Assessment Process – and Stress Testing), Market Risk Management, Non-Financial Risk Management, Compliance and IT. Sometimes different departments are located in the same open-plan office, called a home base. Since my analysis focuses on possible different outcomes in different office areas, the departments located in the same home base have been clustered together for the purpose of my analysis. The distribution of the number of employees working in the different clustered departments is shown in *Figure 4*. Employees who did not state a department/home base in the questionnaire or home bases, which less than three employees specified working in, were summed up under “Not stated”, because no relevant analysis could be conducted with such a small sample size.

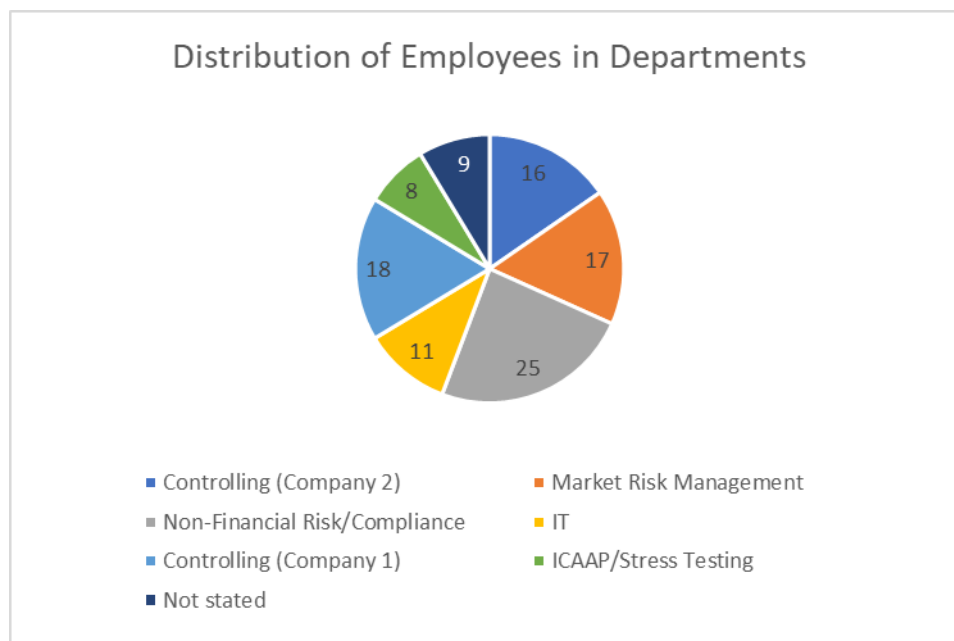


Figure 4: Number of Employees in Departments in Questionnaire

4.1.2 Part Two – Workplace Satisfaction

As mentioned before, this part of the questionnaire is taken from Kim and de Dear's (2013) research paper regarding workplace satisfaction in different office configurations and what influence factors are most relevant for the employees' overall workplace satisfaction. My intention is to compare the results which I derived from the questionnaire with the results stated in the paper from Kim and de Dear (2013) to support their findings and identify possible deviations. More extensive analysis will be conducted in a later chapter. This should only serve as a first overview of the collected data and for gaining initial insights.

As a first step, the average employee satisfaction concerning the workplace is calculated for every satisfaction item from the questionnaire, which is depicted in detail in *Figure 5*. Moreover, the items shown in *Figure 5* are sorted in a way that the item with the highest average satisfaction level is on the left and the average satisfaction level decreases when going to the right. *Figure 5* confirms the results, which can already be seen in the literature review section, namely that the factors achieving the lowest average satisfaction levels, and therefore the trouble makers in an open-plan office environment, are: Noise level, sound and visual privacy and the rotation of the workplace. The amount of space is overall positively rated concerning the average figures since the majority of employees is very satisfied with this specific factor while on the contrary some employees are very dissatisfied.

The average ratings of the items ease of interaction and overall satisfaction show clearly that the employees are overall satisfied with the communication in the office environment and the office setting in general. The negative impact on the overall satisfaction that would be expected from the dissatisfaction with the before-mentioned factors noise, privacy and the rotation of the workplace does not seem to be as strong as one would expect, since the overall satisfaction is still very positively perceived by the employees.



Figure 5: Mean Workplace Satisfaction

For a further analysis and a deeper dive into the factors which influence employee satisfaction the most, I will follow the approach of Kim and de Dear (2013) and cluster the data into three groups according to the employees' answers in the questionnaire items to receive better insights through summarization of the data. This serves the purpose by focusing only on both ends of the spectrum, therefore identifying the highly satisfied and highly dissatisfied employees by division into three subgroups as follows:

- **Satisfied:** Consists of the Likert Scale items "Very Satisfied" and "Satisfied"
- **Neutral:** Consists of the Likert Scale items "Mildly Satisfied", "Neutral" and "Mildly Dissatisfied"
- **Dissatisfied:** Consists of the Likert Scale items "Dissatisfied" and "Very Dissatisfied"

Figure 6 shows the four items concerning workplace satisfaction which yield the highest amount of dissatisfied employees with respect to the before-mentioned grouping of the results. Noise level, sound privacy and visual privacy are as expected amongst the highest percentages of dissatisfied employees, which is in line with the research mentioned in the literature review part of my thesis as well as with the specific results of Kim and de Dear (2013), who also mention these three factors to be worse

in open-plan office configurations compared to other office types. The daily rotation of the workplace also shows elevated levels of dissatisfaction, which will be analyzed in more detail in later chapters. Due to employees having no fixed workstation, the storage amount for personal items is limited to a locker located in the open-plan office, which might be too little space for some employees and therefore cause a certain degree of dissatisfaction.



Figure 6: Items with the highest amount of dissatisfied employees

Air quality and temperature have around 10% of the employees dissatisfied, which could be caused by the impossibility to regulate the temperature or air conditioning by the employees themselves according to their wishes, however they have to accept a fixed setting, which is centrally regulated for the whole office area.

As can be seen in *Figure 7* below, the office furniture and the cleanliness of the building have the majority of employees satisfied, nevertheless these factors do not seem to have a high impact on the overall workplace satisfaction as shown in later chapters. The ease of interaction has a very positive rating as well, consisting of 67% satisfied employees, which might indicate that communication between employees is indeed improved by an open-plan office setting as claimed by employers. This is a very

controversial topic, since employers advertise the advantages of open-plan office settings by claiming that this office environment has a positive effect on the ease of interaction, while this is not yet verified by research. Some research (e.g. Bernstein and Turban, 2018) reveal that open-plan office configurations might even have quite the opposite effect on communication between employees by suggesting a decrease in face-to-face communication in said office setting.



Figure 7: Items with the highest amount of satisfied employees

The item of overall workplace satisfaction can be viewed very positively, considering almost 60% are satisfied with the office environment and only 5% are dissatisfied. This directly contradicts research, which claims that workplace satisfaction for employees in open-plan office configurations is likely to be low. These high satisfaction levels might stem from the new and innovative office buildings depicted in my survey, where the employer has had the possibility to already include existing research in the design process of the building and therefore avoid known problems involving this office concept and furthermore yield a higher overall workplace satisfaction than what would be expected according to research.

4.1.3 Part Three – Open-Plan Specific Factors

This part of my thesis focuses on the specific problems and opportunities that might arise in the context of open-plan office environments. It consists of items which employees have rated on a scale from 1 (strongly disagree) to 5 (strongly agree). The items are derived from literature research as well as input from my own experiences at working in an open-plan office configuration. My intention is to find out how employees see different matters, which are in my opinion worth discussing, and what improvements they would like to see in their immediate working environment.

In the following *Table 1* the average ratings of the items evaluated by the employees are depicted. The ones with the highest degree of agreement or disagreement on average are marked with a rectangle in Table 1 and discussed in more detail below:

- Type of task: The average of 4,21 and therefore strong agreement with this item indicates that the majority of the questionnaire recipients have to perform cognitively demanding tasks during their workday and focus and concentration is essential for a good task performance. Since employees who work on cognitively demanding tasks are the most impaired ones by various sources of noise, I would like to find out in further analysis in later chapters if the employees who are performing cognitively demanding tasks also recognize noise as a distraction from their tasks.
- Privacy: That on average the employees feel like they cannot have a confidential conversation without other colleagues overhearing furthermore supports the beforehand discovered relevance of the negatively perceived sound privacy in open-plan office concepts.
- Workplace rotation: The fact that no employee has their own fixed spot and every day a new spot can/should be picked is not liked by many employees, shown by leaning towards disagreement concerning the respective item with an average of 2,31. Employees therefore tend to sit at the same spot everyday if possible, depicted by the resulting average. A factor that might influence this result could be the desk sharing rate in the home base. If there are enough spots for everyone available to choose from, it is easier to find a satisfying spot and employees might be more satisfied with the rotation of their workplace. On the contrary, if the home base is already full when they arrive or there are only

a few empty spots left, their satisfaction might take a hit. Therefore, I would like to compare the workplace rotation related items with respect to the different home base areas in later chapters to find out if there are significant differences between home bases, possibly influenced by the desk sharing rate, concerning workplace satisfaction.

- Flexible Working: Most employees need a desk and a screen for the majority of their tasks according to this questionnaire item being rated with an average of 4,46. This certain need of office equipment could restrict employees in the use of all the different available working areas in an open-plan environment and in consequence lower the employees' job satisfaction, which will be analyzed in later chapters.

An average of 1,96 for the item concerning different working areas indicates that employees do not take the opportunity to work from different areas which can be used for working. This not only includes different areas in the home base, but also areas outside of the usual designated workspaces, such as a terrace or a Café on the company grounds. This outcome can be linked to various reasons. Some employees are not allowed to work outside of their designated home base due to compliance, data security and data protection reasons. If this result is also linked to the fact that the majority of questioned employees require a screen and a desk to conduct their work will be analyzed further in a later chapter.

- Purpose of open-plan concepts: With an average of 4,13 the employees indicate that they understand why open-plan offices are being used. In further analysis I would like to investigate if understanding the idea behind this office concept and job satisfaction are linked. My proposition is that if an employee understands the purpose and advantages of this open-plan environment, he or she is also more likely to embrace this office form and use its full potential and behave considerately.

	Items	Ø Score
Type of Task	The majority of tasks I have to perform during a workday are cognitive demanding tasks and I have to focus and concentrate in order to perform well.	4,21
Noise	Noise in the office (e.g. other co-workers talking, telephones ringing) are distracting me from my tasks.	3,65
	I feel, when there is a lot of noise in the office, it takes me longer to perform a task.	3,83
Privacy	I feel like I can have confidential conversations with colleagues in the office without others overhearing them.	2,49
	I often overhear other colleagues talking due to the office layout.	3,58
	I regularly use the provided phone cells to make phone calls.	3,38
	I feel like I can have confidential phone conversations in the phone cells.	3,39
	I feel uncomfortable when co-workers walk by and have a clear view of my screen.	3,21
Workplace Rotation	When I come in the morning, there are a lot of different workplaces available that I can choose to work at.	3,17
	When I want to work concentrated, I choose to sit at a focus area (higher walls, cubicle-like).	3,11
	I like the concept of no fixed spots, so I can sit where my project needs are best met.	3,19
	I usually find a spot I like working at.	3,79
	I like sitting at a different spot every day.	2,31
	I would prefer to work in a private office or cell office (up to 4 people) rather than in an open space office.	2,87
Flexible Working	The work I am doing usually requires a desk and a screen.	4,46
	I feel that I can be more creative in an open office configuration.	3,04
	I take the opportunity to do home office once a month or more often.	2,95
	I use different areas outside my homebase for working regularly (e.g. terrace, Café, etc.)	1,96
	I see the opportunity of doing home office as a needed compensation for the open office layout.	2,99
Ergonomics	I take my time in the morning to adjust my chair, desk and screen to my personal preferences.	3,71
	I use the possibility to work while standing up sometimes.	3,05
	I regularly have back or neck pain.	2,59
Improvements	I would like to have a separate office area, where it is more silent (e.g. no talking allowed, no phone calls allowed).	3,41
	I would like to have more think tanks/meeting rooms in the homebase for work discussions with colleagues.	3,62
	I would like to have more or higher partitions in the office.	3,25
	I would prefer a docking station for my laptop rather than plugging in everything separately (e.g. LAN cable, screen cable, charger).	3,43
Considerate Behavior	When I talk to a colleague about non-work-related things I prefer to go to the kitchen instead of talking in the office.	3,64
	I usually clear my desk when I am not using it for more than 3 hours.	2,51
Others	I understand the purpose of open space office concepts and why they are used.	4,13
	I rarely do non-work-related things in the office.	3,84
	Only if you have worked in a private office or cell office (up to 4 people in an office) before, otherwise leave empty: I prefer working in an open space office over working in the above-mentioned office types.	2,99

Table 1: Average Item Ratings

4.2 Testing of Hypotheses and Statistical Analysis

After gaining a broad overview of the collected data in the previous chapter, I now dive a little deeper. The testing of the hypotheses is performed on the questionnaire results via statistical analysis and adequate tests, which are most appropriate for the respective hypothesis. The statistical tests are conducted in the open source software R due to its great availability of various statistical analysis tools.

This chapter contains one subchapter for the testing of each of the stated hypotheses, which are described in detail in chapter [2.5 Deriving the Hypotheses](#). Also included are the underlying assumptions of those and a description of the statistical methods used for rejecting or not rejecting the different hypotheses.

4.2.1 Preparation of Data for Statistical Analysis

For certain statistical tests, the data has to fulfill a number of prerequisites. In this chapter I will describe the data checks and data manipulation which has been performed before the execution of any statistical analysis.

- **Empty values:** Some statistical tests and procedures do not allow missing values in the dataset, for example the backward selection for linear regression models in R, and therefore do not work or do not show correct results if the data set contains empty fields. In these cases, I removed the questionnaires, which enclose missing values. Note, that these questionnaires will remain in the dataset for other tests, which might need other parts of the questionnaire, that are complete and without missing values. So, questionnaires with empty fields are not excluded in general from the analysis in order to not lose valuable insights.
- **Normality:** In my questionnaire I mainly used the Likert Scale to evaluate different items. Since this involves an ordinal scale, the data can never be normally distributed, which would require at least a continuous distribution. Therefore, attention has to be paid when performing statistical tests on the dataset. A lot of tests used for analyzing data, such as the t-test, require a dataset following a normal distribution and therefore such tests which require a

normal distribution cannot be used in this context. For example, instead of applying the t-test on the Likert Scale items of my dataset, which is not appropriate in this situation, I rather use the non-parametric Mann-Whitney-U-test.

- **Level of Significance:** For all statistical tests in my thesis, I use a significance level alpha of 0.05, which is most commonly used in research in the scientific field of my thesis. The significance level indicates if the null hypothesis is rejected or not, and in this case the null hypothesis is only rejected if a p-value of smaller than 0.05 is achieved.

4.2.2 Hypothesis 1 – Workplace Satisfaction Compared to Previous Research Results

H1: The overall workplace satisfaction is mainly affected by the employees' satisfaction with noise, visual privacy, sound privacy and the ease of interaction.

As a first step, I have created a correlation matrix including all 16 items from part two of the questionnaire (concerning workplace satisfaction) to check if some variables are significantly correlated and thus the future linear regression model might have a multicollinearity problem. The complete correlation matrix is shown in the following *Table 2*, where it can clearly be seen that there are five instances of moderate to high correlation between the independent variables which will be used for a linear regression model in a later stage, thus attention has to be paid concerning multicollinearity within said model.

	Temper- ature	Air Quality	Amount of Light	Visual Comfort of Lighting	Noise Level	Sound Privacy	Amount of Space	Workplace Rotation	Visual Privacy	Ease of Interaction	Office Furnishings	Adjustability of Furnishing	Colors and Texture	Building Clean- liness	Workspace Clean- liness	Building Main- tenance
Temperature	-	0,67	0,27	0,23	0,45	0,37	0,23	0,32	0,32	0,07	0,34	0,23	0,29	0,40	0,34	0,40
Air Quality	-	-	0,41	0,44	0,40	0,34	0,24	0,28	0,39	0,02	0,23	0,18	0,30	0,36	0,25	0,39
Amount of Light	-	-	-	0,64	0,30	0,25	0,36	0,07	0,29	0,12	0,26	0,36	0,41	0,46	0,37	0,45
Visual Comfort of Lighting	-	-	-	-	0,38	0,31	0,45	0,23	0,41	0,23	0,21	0,27	0,33	0,41	0,28	0,43
Noise Level	-	-	-	-	-	0,59	0,43	0,51	0,55	0,33	0,32	0,29	0,38	0,35	0,31	0,28
Sound Privacy	-	-	-	-	-	-	0,49	0,52	0,52	0,19	0,31	0,36	0,26	0,31	0,23	0,28
Amount of Space	-	-	-	-	-	-	-	0,51	0,58	0,33	0,40	0,38	0,25	0,28	0,32	0,40
Workplace Rotation	-	-	-	-	-	-	-	-	0,55	0,41	0,15	0,15	0,15	0,21	0,18	0,11
Visual Privacy	-	-	-	-	-	-	-	-	-	0,35	0,28	0,22	0,18	0,28	0,24	0,33
Ease of Interaction	-	-	-	-	-	-	-	-	-	-	0,31	0,20	0,10	0,25	0,25	0,28
Office Furnishings	-	-	-	-	-	-	-	-	-	-	-	0,68	0,34	0,32	0,29	0,37
Adjustability of Furnishing	-	-	-	-	-	-	-	-	-	-	-	-	0,36	0,34	0,35	0,36
Colors and Texture	-	-	-	-	-	-	-	-	-	-	-	-	-	0,47	0,38	0,39
Building Cleanliness	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0,71	0,68
Workspace Cleanliness	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0,55
Building Maintenance	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Table 2: Correlation matrix of the 16 independent variables concerning workplace satisfaction

As a next step, I have computed a linear regression model which uses the overall satisfaction as the dependent variable and the other remaining 16 items from part two of the questionnaire (concerning workplace satisfaction) as independent variables. In

Table 3 one can see that the complete model, including all available independent variables, yields a significant impact only for visual privacy on overall satisfaction. Given the descriptive analysis in previous chapters and existing literature one would expect to see at least noise and sound privacy as additional influence factors for the overall workplace satisfaction. This insignificant outcome for the depicted variables might be the result of a multicollinearity problem within the model as already expected from the correlations shown in *Table 2*.

	Estimate	Std.Error	t-value	p-value
(Intercept)	0,37	0,62	0,59	0,55
Temperature	0,08	0,06	1,30	0,20
Air Quality	-0,04	0,07	-0,55	0,59
Amount of Light	0,07	0,08	0,91	0,36
Visual Comfort of Lighting	0,05	0,09	0,57	0,57
Noise Level	0,13	0,07	1,86	0,07
Sound Privacy	0,10	0,06	1,61	0,11
Amount of Space	0,07	0,06	1,12	0,26
Workplace Rotation	0,12	0,07	1,81	0,07
Visual Privacy	0,20	0,07	2,99	0,00
Ease of Interaction	0,13	0,08	1,65	0,10
Office Furnishings	-0,10	0,10	-1,00	0,32
Adjustability of Furnishing	0,16	0,09	1,70	0,09
Colors and Texture	0,09	0,07	1,22	0,23
Building Cleanliness	-0,07	0,13	-0,54	0,59
Workspace Cleanliness	-0,03	0,09	-0,31	0,76
Building Maintenance	0,10	0,09	1,09	0,28
Adjusted R ²	0,68			
Significance F-Test	0.00			

Table 3: Complete linear regression model of second part of questionnaire (workplace satisfaction)

The complete model shown in *Table 3* yields a value of 0,68 for the adjusted R² of this linear regression model, which is a very good result for questionnaires of this type. This adjusted R² value means that 68% of the model's variance is explained by the currently used model. Nevertheless, it could be that redundant variables or variables which cause an overfit are still included in the regression and therefore the adjusted R² value could still be improved. An improvement of the adjusted R² value through a modified linear regression model generally means that the previously used model is not the best fitting one for the data. Such improvement can be achieved by leaving out certain

variables causing multicollinearity or an overfit. The multicollinearity problem for the complete linear regression model in *Table 3* was already expected from the results in *Table 2*.

To further test the linear regression model for multicollinearity, the variance inflation factor is calculated for the existing complete linear regression model in *Table 3*. In the following *Table 4*, it can be seen that almost all variables show a variance inflation factor higher than two, which means that multicollinearity is strongly present in the existing linear regression model and therefore the model should be reduced through leaving out variables that are redundant and therefore cause multicollinearity.

Temperature	2,34
Air Quality	2,38
Amount of Light	2,11
Visual Comfort of Lighting	2,20
Noise Level	2,20
Sound Privacy	2,02
Amount of Space	2,33
Workplace Rotation	2,39
Visual Privacy	2,12
Ease of Interaction	1,63
Office Furnishings	2,38
Adjustability of Furnishing	2,23
Colors and Texture	1,55
Building Cleanliness	3,06
Workspace Cleanliness	2,23
Building Maintenance	2,49

Table 4: Variance inflation factor for independent variables in the linear regression model

With regard to the results in *Table 2* and *Table 4* and the subsequent multicollinearity issue, I have decided to create a new and more sophisticated linear regression model by performing a stepwise selection algorithm, which is based on the Akaike Information Criterion (AIC). This algorithm is a backward elimination algorithm, meaning that it starts with the complete model as a basis and then takes away certain variables step by step, which do not contribute to a sufficient model. The exclusion of before-mentioned variables is solely based on the improvement of the used criterion, which is in this case the AIC. To then deliver the improved model, the backward elimination

process has taken eight steps for reaching the best fit according to AIC. This new linear regression model is displayed in *Table 5*.

	Estimate	Std.Error	t-value	p-value
(Intercept)	0,46	0,51	0,91	0,367
Amount of Light	0,13	0,06	2,05	0,043
Noise Level	0,16	0,06	2,51	0,014
Sound Privacy	0,11	0,06	1,75	0,084
Amount of Space	0,08	0,06	1,37	0,174
Workplace Rotation	0,13	0,06	2,10	0,038
Visual Privacy	0,20	0,07	3,09	0,003
Ease of Interaction	0,11	0,07	1,63	0,106
Adjustability of Furnishing	0,13	0,07	1,80	0,075
Adjusted R ²	0,68			
Significance F-Test	0,00			

Table 5: Reduced Model through Stepwise Selection (AIC)

The reduced linear regression model in *Table 5* shows that visual privacy, noise level, workplace rotation and amount of light have the most significant impact on the overall workplace satisfaction of employees in open-plan office environments, in decreasing order of significance. The variables ease of interaction and sound privacy are not significant in the above-mentioned model, although a trend is recognizable. Therefore, H1 can only be accepted concerning the variables visual privacy and noise level, while it must be rejected for sound privacy and the ease of interaction.

Nevertheless, this finding can support employers by suggesting where to focus on, when designing an ideal office configuration, which will accommodate happy employees. The most important aspects when looking at employee satisfaction in an open-plan office environment, are the above-mentioned areas of significance. Improving the satisfaction in these certain categories, the overall workplace satisfaction of an employee will therefore also rise according to the linear regression model in *Table 5* and moreover improve the employees' well-being.

4.2.3 Hypothesis 2 – Workplace Satisfaction is Depending on the Previous Working Experience Further Influenced by the Age of Employees

H2: Employees with previous experience in more private office settings are less satisfied with the open-plan office layout than the ones without previous experience.

As a starting point, the average overall satisfaction levels of employees with and employees without previous experience in more private office forms are shown in the following *Figure 8*. This graph clearly shows that there is almost no difference in satisfaction levels between employees with and employees without previous experience in more secluded office areas. Employees without previous experience in other office forms are even less satisfied with an average satisfaction level of 5.3 than employees with previous experience, who yield an average satisfaction level of 5.4, thus directly contradicting hypothesis 2.

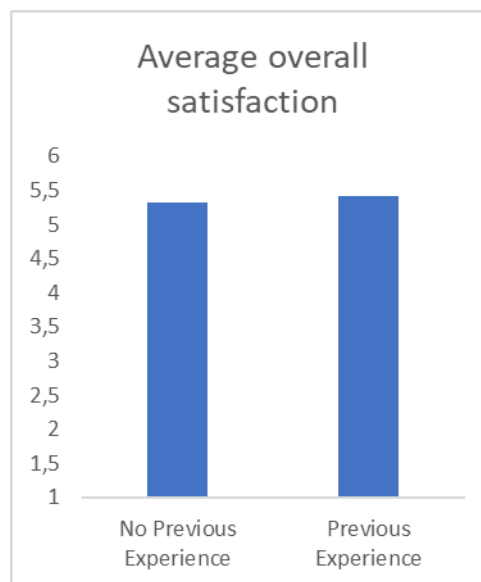


Figure 8: Average overall satisfaction level of employees without previous working experience in more private office forms and employees with such experience

To better understand the outcome in *Figure 8*, a deep dive into the data is provided by the graph in *Figure 9*, which shows that the majority of employees who prefer the more secluded office setting over the open-plan environment are overall satisfied or have at least a neutral opinion towards the office environment while only 15% out of the employees of this group are dissatisfied. On the other side, the employees who have no previous working experience in private offices show a very high amount of neutral opinions towards the open-plan office environment with a total of 46%, while the share of satisfied employees in this group is only slightly higher with 50%. This explains the higher overall satisfaction levels for employees possessing previous experience.

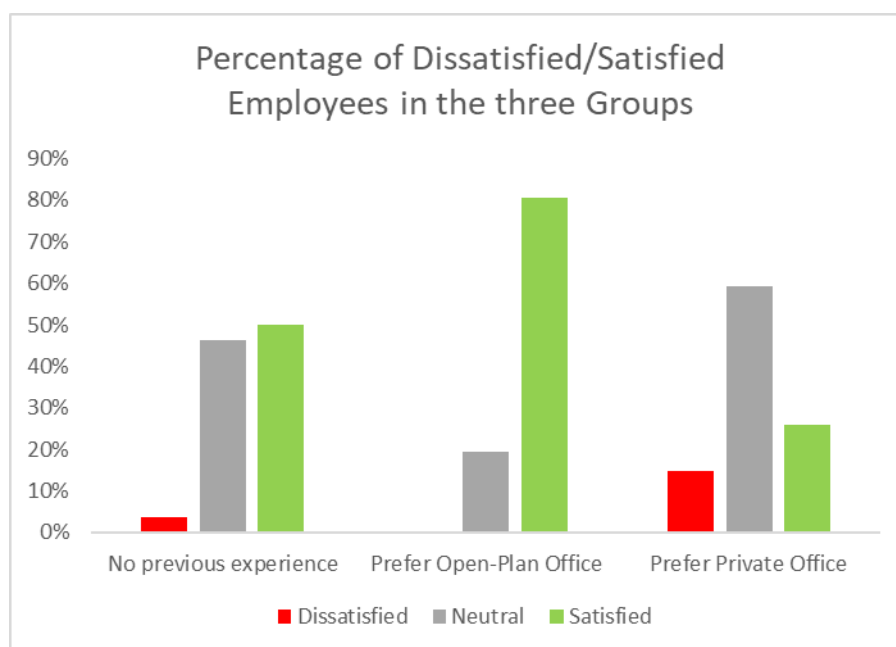


Figure 9: Percentage of dissatisfied, neutral and satisfied employees for the three groups: no experience with private offices, employees who have this experience and prefer or don't prefer open-plan offices

As a second step, I analyze how the age of the employees is connected to the preference for private offices or open-plan environments. For the purpose of simplifying the analysis process, the employees are clustered into three age groups, similar to the approach by Kim and de Dear (2013). Since the categorization by Kim and de Dear would lead to a very unevenly distributed number of employees for my dataset, I chose a slightly different approach. I designed the age ranges in a way so that on one hand the employees are split into roughly the same number of employees in each group to avoid an unreliable result caused by a small sample size. Secondly, each group

contains a span of around ten plus years to guarantee a big enough age gap between the groups to enhance the meaningfulness of the analysis. Therefore, the age groups are established as:

- “30 or under” including 29 employees
- “31-40” including 39 employees
- “Over 40” including 29 employees

In the first part of this chapter, it becomes clear that the lack of previous working experience alone does not automatically lead to a higher overall satisfaction level as can be seen in *Figure 8*. Therefore, I show the factor of age in combination with the previous working experience, assuming employees of a different age perceive the working environment in a different way, to gain better insights in what reflects on the overall workplace satisfaction.

The following *Figure 10* depicts the three different age groups, their preference towards open-plan offices or private office forms and the average overall satisfaction.

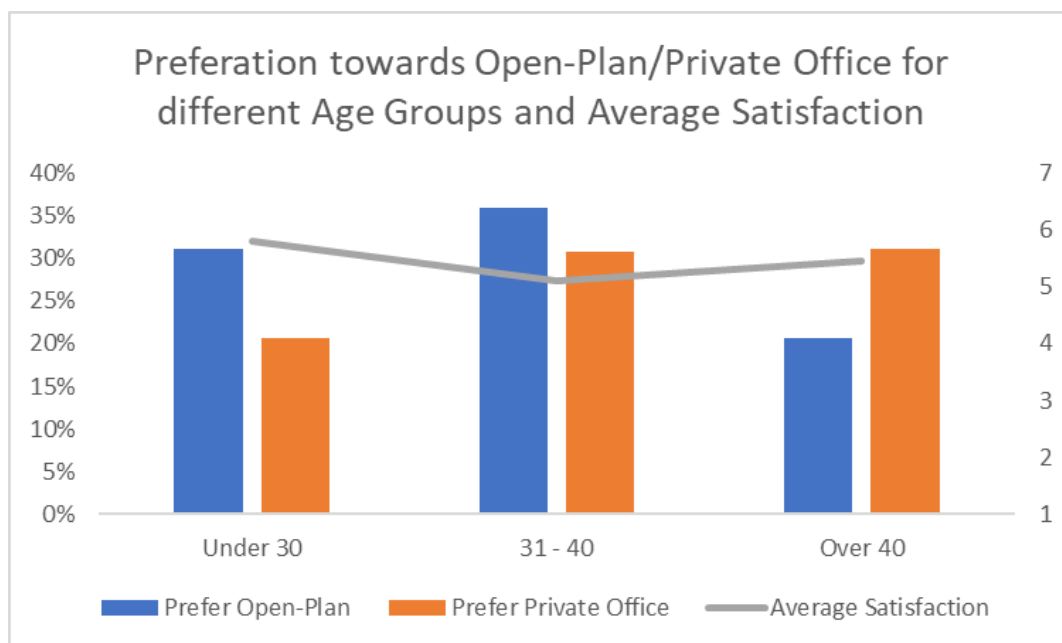


Figure 10: Comparison of different items throughout the three age groups (neutral opinions towards the preference of open-plan or private/cell offices have been left out of the graph)

In *Figure 10* one can see that the youngest age group yields the highest average overall satisfaction score with a value of 5.79, followed by the oldest age group with a value of 5.45 and conclusively the employees aged between 31 and 40 are the least satisfied with an average of 5.10. A very interesting result is depicted in the bar chart in *Figure 10*. 36% of the middle-aged group, consisting of employees between 31 and 40 years, prefer the open-plan office over more private office types, which is the highest percentage out of all three age groups for the preference of the open-plan office. Yet the middle-aged group yields the lowest average overall satisfaction score out of the three age groups, which is counterintuitive considering that the majority in this group prefers the open-plan environment. While the oldest age group reaches a higher average overall satisfaction level in comparison to the middle-aged group, although only 21% out of this group prefer the open-plan environment over a more secluded office area.

Since the variable of overall workplace satisfaction seems to have a non-linear relationship with the age of the employees, it might be interesting to examine this context further in more sophisticated models, potentially in combination with the employees' previous working experience, but this would go beyond the scope of my thesis.

4.2.4 Hypothesis 3 – Differing Satisfaction Levels in Separate Working Areas

H3: There are significant differences concerning relevant factors for open-plan office environments between the single working areas.

As a first step I evaluate if and where there are statistically significant differences in the overall workplace satisfaction of employees between all working areas as a starting point. As a next step, all items from the second and third part of the questionnaire are evaluated for every combination of clustered departments to dive deeper into this topic and identify possible deviations and examine and explain them to the best possible extent.

The following *Table 6* shows the p-values retrieved from conducting several Mann-Whitney-U-Tests, one for each working area, indicating if there are significant differences in overall workplace satisfaction between the departments. For an easier readability of the table, a letter representing each clustered department has been used. The key is as follows:

- A: Controlling (Company 2)
- B: Market Risk Management
- C: Non-Financial Risk/Compliance
- D: IT
- E: Controlling (Company 1)
- F: ICAAP/Stress Testing

A vs. B	A vs. C	A vs. D	A vs. E	A vs. F	B vs. C	B vs. D	B vs. E
0.46	0.86	0.36	0.14	0.90	0.23	0.71	0.34
B vs. F	C vs. D	C vs. E	C vs. F	D vs. E	D vs. F	E vs. F	
0.73	0.21	0.06	0.91	0.69	0.61	0.42	

Table 6: P-values for comparison of overall satisfaction between all available home bases

As can be seen in *Table 6* above, there are no significant differences in overall workplace satisfaction between the departments, which is the most interesting aspect to look at, since overall satisfaction should be the main focus of an employer. Nevertheless, there are significant differences in other questionnaire items, I would like to point out and find explanations for. Since I only want to highlight certain aspects and the most interesting findings in the following, the complete table can be found in the Annex under Chapter 7.4.1 for the interested reader.

I will now highlight and discuss the questionnaire items that have the highest number of significant differences between working areas.

The first questionnaire item I will analyze is the rating of “I often overhear other colleagues talking due to the office layout”, which shows the most differences between working areas. The respective p-values are moreover depicted in *Table 7*. This item can be classified under the category “Sound Privacy”. Therefore, it is not surprising that although this specific item shows significant differences between departments, the overall workplace satisfaction does not. As already shown in the linear regression model in 3.3.2 Hypothesis 1, sound privacy is not a significant variable for explaining the overall workplace satisfaction and thus of little relevance concerning this issue.

A vs. B	A vs. C	A vs. D	A vs. E	A vs. F	B vs. C	B vs. D	B vs. E
0.05	0.01	0.74	0.45	0.57	0.27	0.02	0.18
B vs. F	C vs. D	C vs. E	C vs. F	D vs. E	D vs. F	E vs. F	
0.01	0.00	0.03	0.00	0.28	0.76	0.14	

Table 7: P-values regarding the comparison of the questionnaire item “I often overhear other colleagues talking due to the office layout” between departments

For a better understanding of the uncovered differences concerning the above-mentioned item, I use the following *Figure 11* to show the percentage of employees who agree with the item, the percentage of employees who disagree and the arithmetic mean for the above discussed item per working area.

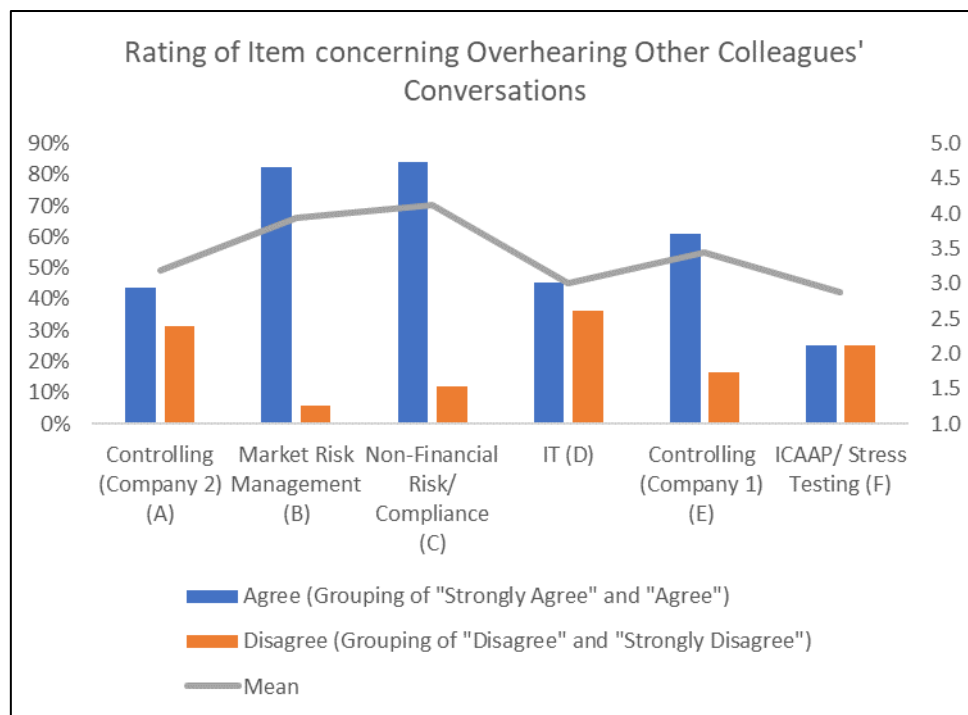


Figure 11: Percentage of employees who agree with the item "I often overhear other colleagues talking due to the office layout", percentage of employees who disagree and the arithmetic mean (neutral answers not depicted)

The blue bars in *Figure 11* show the percentage of employees in each department who agree with the item mentioned above, while the orange bars depict the relative amount of employees who disagree with the item. For the purpose of simplification, the category "Disagree" is a grouping of the Likert Scale items "1 – Strongly Disagree" and "2 – Disagree", while "Agree" consists of the ratings "4 – Agree" and "5 – Strongly Agree", similar to the grouping approach in 4.1.2 Part Two – Workplace Satisfaction. "3 – Neutral" answers have been left out of the graph due to the little interest in this context. The arithmetic mean of all answers per working area is depicted as well on the secondary axis of *Figure 11*.

Figure 11 shows that the home bases, where the areas Controlling (Company 2), IT and ICAAP/Stress Testing are located at are quite balanced between employees who feel like they can often overhear other colleagues talking and employees who do not feel that way. While over 80% of the employees in the departments Market Risk Management and Non-Financial Risk/Compliance, and over 60% in the area Controlling (Company 1) feel like their conversations in the home base are not private. Since all home bases have the same basic structure, elements and partitions, this result is most likely not caused by the physical environment, but more likely by other

factors. A few explanations for these peaks in the areas where Market Risk Management, Non-Financial Risk/Compliance and Controlling (Company 1) are located at could be that more people are assigned to these home bases and therefore more workstations are occupied, thus being more likely to overhear someone. Also, the areas of Risk Management and Controlling are Compliance areas, dealing with sensitive data and therefore it might be more important for the employees working in these areas to be able to have a confident conversation than for employees in other departments. Another reason could be that the organizational culture is different within each home base. Therefore, employees in other home bases could be more considerate by using think tanks or meeting rooms to have conversations and thus less people overhear something directly in the open-plan office. These possible explanations cannot be elaborated further in the extent of my thesis but would be a good starting point for further research.

The next item with great variance between the clustered departments I would like to highlight concerns the item "I take the opportunity to do home office once a month or more often". The p-values for the Mann-Whitney-U-Test between the working areas can be seen in *Table 8*.

A vs. B	A vs. C	A vs. D	A vs. E	A vs. F	B vs. C	B vs. D	B vs. E
0.47	0.00	0.03	0.01	0.03	0.00	0.08	0.02
B vs. F	C vs. D	C vs. E	C vs. F	D vs. E	D vs. F	E vs. F	
0.05	0.08	0.16	0.77	0.59	0.37	0.49	

Table 8: P-value for Mann-Whitney-U-Test, comparing the ratings of the item "I take the opportunity to do home office once a month or more often" between working areas

Following the same approach as for the previously considered questionnaire item, a graph is generated in *Figure 12* to enable a better understanding, of what the differences between the working areas are.

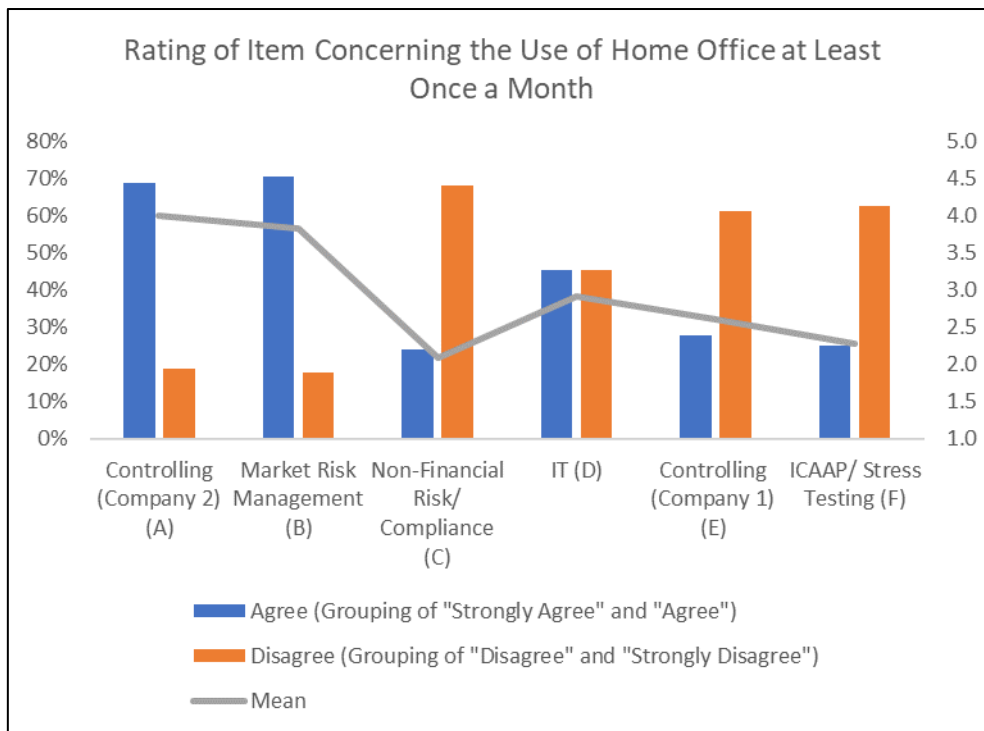


Figure 12: Percentage of employees who agree with the item "I take the opportunity to do home office once a month or more often", percentage of employees who disagree and the arithmetic mean

Figure 12 shows that around 70% of the employees from the areas Controlling (Company 2) and Market Risk Management use the opportunity to take home office at least once a month, while only under 30% of the employees from the departments Non-Financial Risk/Compliance, Controlling (Company 1) and ICAAP/Stress Testing take this opportunity. So, there are clearly big differences concerning the home office culture within the companies itself. This can have various reasons. In some departments, employees are simply not allowed to do home office due to the sensitivity of the data they work with as mentioned in previous chapters. To protect this delicate company data from the outside environment, it is therefore prohibited for employees to conduct their tasks anywhere outside of their designated home base, including their own home. Moreover, no employee has the untouchable right to do home office, meaning that in any case the direct supervisor has to approve the home office request from an employee and can also deny it if there is reason to do so. Some managers are more reluctant to grant home office days than others, depending on their personal opinion on home office, their employees or the types of tasks. Therefore, employees in one department might gain access to the right of conducting home office easier than the ones in another and thus use it more often.

Home office is also not suitable for every type of task. If an employee has to conduct tasks that only he or she is responsible for and which can be done perfectly alone, it is likely that the employee will work from home every now and then. But, if a task is performed in a team or requires attendance in meetings regularly, taking home office becomes much more difficult. Therefore, regarding some types of tasks home office might seem more like a burden than an opportunity to an employee and thus is not being used as much or not at all in these cases.

The next questionnaire item I would like to take a closer look at due to its great variance between the clustered departments is “When I come in the morning, there are a lot of different workplaces available that I can choose to work at.” The p-values for the Mann-Whitney-U-Test between the working areas can be seen in *Table 9*.

A vs. B	A vs. C	A vs. D	A vs. E	A vs. F	B vs. C	B vs. D	B vs. E
0.434	0.068	0.549	0.398	0.111	0.202	0.066	0.038
B vs. F	C vs. D	C vs. E	C vs. F	D vs. E	D vs. F	E vs. F	
0.176	0.009	0.002	0.604	0.859	0.025	0.016	

Table 9: P-value for Mann-Whitney-U-Test, comparing the ratings of the item "When I come in the morning, there are a lot of different workplaces available that I can choose to work at" between working areas

Following the same approach as for the previously considered questionnaire items, a graph is generated in *Figure 13* to enable a better understanding, of what the differences between the working areas are.

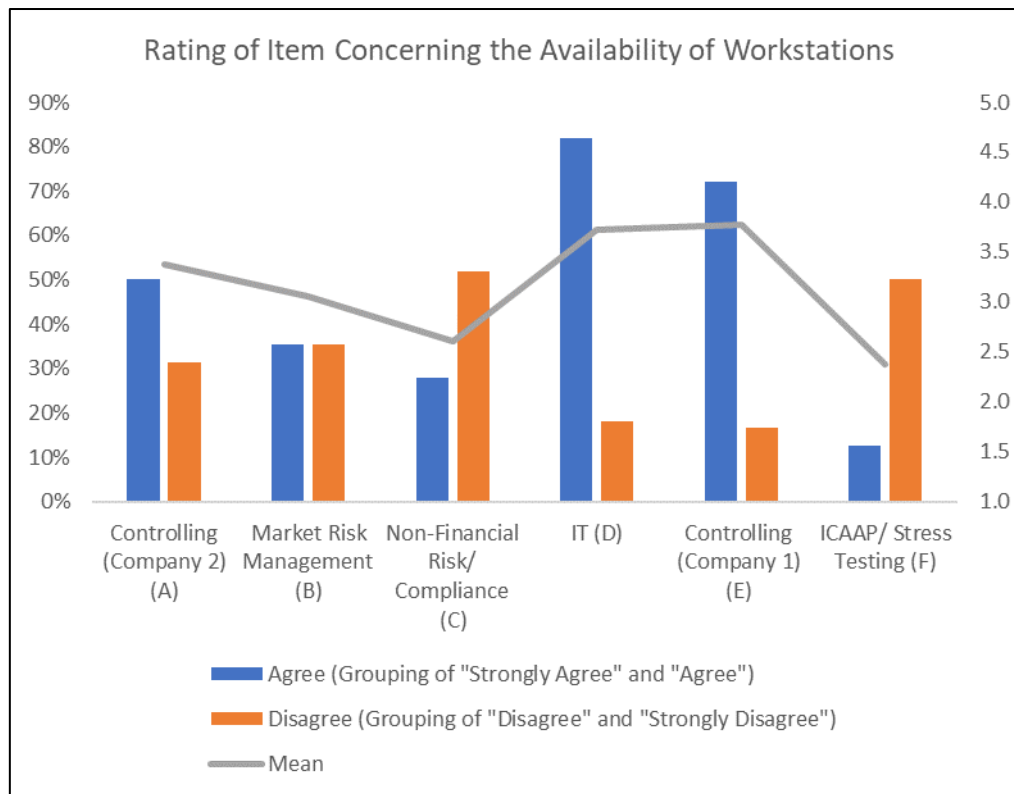


Figure 13: Percentage of employees who agree with the item "When I come in the morning, there are a lot of different workplaces available that I can choose to work at", percentage of employees who disagree and the arithmetic mean

Figure 13 shows that 82% of the employees in the IT department and 72% of the employees in the Controlling area of Company 1 feel like there are a lot of available workstations to choose from. While especially in the area ICAAP/Stress Testing and Non-Financial Risk/Compliance the majority of employees feels like there is a shortage of workstations. This clearly shows that within the company the distribution of employees to home bases is very heterogenous, which might stem from the home office culture differentiating greatly between the departments, leading to an excess of workstations in one area, while there is a shortage of available workplaces in another. The differing home office culture is already shown in Figure 12 above. For the overall impact of the shortage of available workstations in the office environment I would like to refer to the later tested hypothesis in chapter 4.2.7 Hypothesis 6, which elaborates in detail on the influences a shortage of workstations has on the employees and their well-being in the office.

To better utilize the space in the home bases, it might be helpful to keep track of desk sharing rates or average amount of employees in the home base for a given period of

time to better evaluate if there is a need for additional workstations in one area or if there are a lot of empty workplaces that could be used by employees from other, overcrowded, areas. To put this concept in use might not always be easy, especially if employees need to work in teams and therefore cannot simply move to another home base, where they are separated from their team members. But the unevenly distribution of employees to home bases is a very critical issue, since employees feel a loss of control and personal freedom of choice if they do not have sufficient options to choose workstations from.

The last item I evaluate in detail due to its great variance between the clustered departments is “I feel that I can be more creative in an open office configuration”. The p-values for the Mann-Whitney-U-Test between the working areas can be seen in Table 10.

A vs. B	A vs. C	A vs. D	A vs. E	A vs. F	B vs. C	B vs. D	B vs. E
0.880	0.803	0.022	0.499	0.374	0.651	0.005	0.471
B vs. F	C vs. D	C vs. E	C vs. F	D vs. E	D vs. F	E vs. F	
0.357	0.028	0.311	0.250	0.004	0.003	0.861	

Table 10: P-value for Mann-Whitney-U-Test, comparing the ratings of the item “I feel that I can be more creative in an open office configuration” between working areas

To enable a better understanding, of what the differences between the working areas are, the previous approach is again taken for the questionnaire item “I feel that I can be more creative in an open office configuration” via the graph in *Figure 14*.

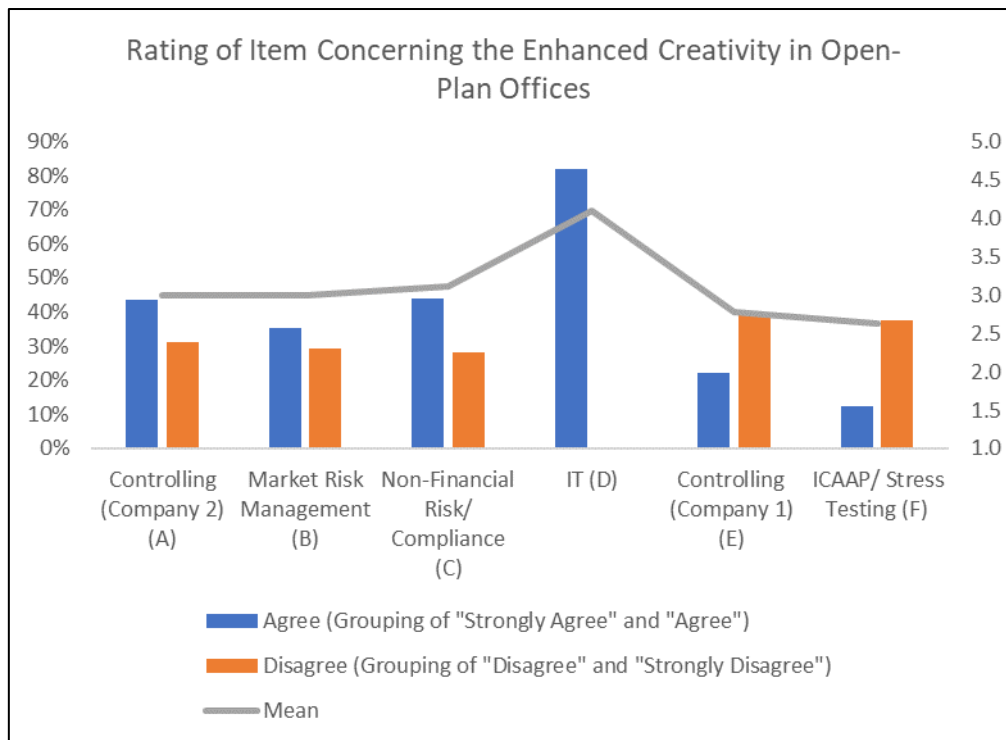


Figure 14: Percentage of employees who agree with the item "I feel that I can be more creative in an open office configuration", percentage of employees who disagree and the arithmetic mean

In Figure 14 one can see that the employees in the IT area feel very strongly that their creativity is enhanced in an open-plan office environment with the vast majority of 82% agreeing to the respective questionnaire item and 0% disagreeing with it. For the departments Controlling (Company 2), Market Risk Management and Non-Financial Risk/Compliance there is a slight tendency towards the creativity-enhancement of the open-plan office, while the employees in Controlling (Company 1) and ICAAP/Stress Testing lean towards the working environment not improving their creativity. This result might be connected to the type of tasks which are performed by the employees in the respective areas. In the IT area it is important to think outside the box, be creative and come up with solutions for certain problems, either during a long-term IT project or for short-term urgent matters brought to them by other employees in the company. Therefore, being creative might be more important in this line of work than for example in Controlling (Company 1) or ICAAP/Stress Testing, where the majority of employees did not find the open-plan environment to be creativity-enhancing. In these before-mentioned areas being creative might not be a part of the daily work conducted by the employees there. Therefore, they might not recognize the effect the open-plan office has on creativity, because it is simply not important or visible in their line of work.

There are 25 more items from the questionnaire which show a high count of significant p-values for the comparison of differences between home bases. Unfortunately, to analyze the above-mentioned 25 items which contain at least one significant p-value, confirming a difference between working areas, would go beyond the scope of my thesis, but could be a basis for further research.

To sum up the analysis for hypothesis 3, as shown above and in the detailed table in 7.4.1 Complete list of p-values for all items, H3 can be confirmed. Since 29 items from the questionnaire exhibit a significant p-value for the difference between at least one pair of working areas, the hypothesis that there are significant differences concerning open-plan office environment relevant topics between the single home bases must be confirmed. Despite 19 items not showing significant differences, including the overall workplace satisfaction, I would overall assess that differences in 29 items are sufficient to confirm hypothesis 3.

4.2.5 Hypothesis 4 – Impact of the Amount of Working Hours

H4: Part-time employees are more satisfied with the open-plan office layout than full-time employees.

To test this hypothesis a Mann-Whitney-U-Test is performed for all satisfaction items on the questionnaire between the group of part-time and full-time employees. Other factors such as age, gender, etc. are not taken into account for evaluating this hypothesis. The resulting p-values can be seen in the following *Table 11*.

Temperature	Air Quality	Amount of Light	Visual Comfort of Lighting
0.29	0.24	0.44	0.61
Noise Level	Sound Privacy	Amount of Space	Workplace Rotation
0.97	0.87	0.18	0.73
Visual Privacy	Ease of Interaction	Office Furnishings	Adjustability of Furnishing
0.17	0.63	0.40	0.95
Colors and Texture	Building Cleanliness	Workspace Cleanliness	Building Maintenance
0.76	0.06	0.01	0.90
Overall Satisfaction			
0.27			

Table 11: P-values for Mann-Whitney-U-Test between part-time and full-time employees concerning all satisfaction items from part one of the questionnaire

By looking at *Table 11* it becomes clear that only the satisfaction with the cleanliness in the workspace is significantly differing between part-time and full-time employees. This result along with other open-plan relevant factors is moreover visualized in *Figure 15* below by showing the average satisfaction levels of full-time and part-time employees concerning certain aspects of the open-plan environment.

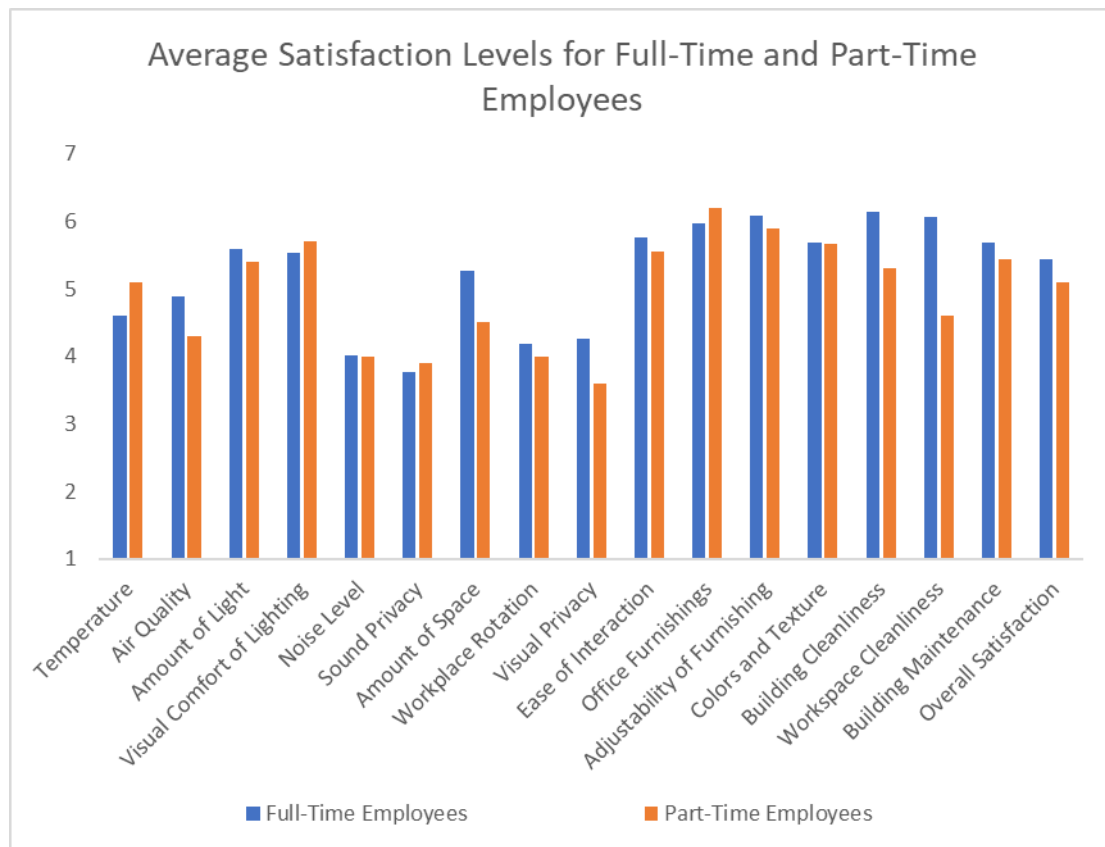


Figure 15: Average satisfaction levels for employees, differentiated by their working hours into part-time and full-time employees (neutral answers as well as not stated ones have been left out of the graph)

From the analysis of the results of *Table 11* and *Figure 15* it becomes obvious that hypothesis 4 must be rejected. Only one satisfaction item, “Workspace Cleanliness”, shows a significant difference between part-time and full-time employees, but most importantly, this finding directly opposes the stated hypothesis by showing the opposite than what was assumed in H4. From *Figure 15* it is clearly visible that the part-time employees are less satisfied than the full-time employees concerning the item of workspace cleanliness, thus directly contradicting H4, which leads to a rejection of said hypothesis. Moreover, although the other differences between groups are not significant, there is a clear trend of full-time employees being more satisfied than part-time employees for almost every remaining satisfaction item on the questionnaire.

Nevertheless, there are some limitations concerning the evaluation of this hypothesis with the data gathered for my thesis. In the respective dataset, the part-time employees consist of only 10% within the observed population, while the full-time employees are represented by 90%. For further research I would suggest to achieve more balanced

sample sizes of the two groups as well as the assumption of a contradicting hypothesis, meaning basing the hypothesis on full-time employees being more satisfied than part-time employees, which is clearly shown in the analysis of *Figure 15*. Of course, then the underlying reasons for this assumption have to be properly evaluated and elaborated.

4.2.6 Hypothesis 5 – Impact of cognitively demanding tasks on noise satisfaction level and task performance

H5: Employees who perform mainly cognitively demanding tasks are less satisfied with noise in the workplace and feel more distracted by noise than those who perform simpler tasks.

In a first step, the employees are split into two groups. Those who agree with the item “The majority of tasks I have to perform during a workday are cognitively demanding tasks and I have to focus and concentrate in order to perform well”, and the ones who disagree. Based on this grouping, a Mann-Whitney-U-Test would be conducted concerning the differences between the two groups for questionnaire items referring to task performance and efficiency. Unfortunately, only three employees consider the majority of their tasks being not cognitively demanding, therefore a Mann-Whitney-U-Test would not yield a meaningful result.

Due to the lack of data when splitting the employees in two groups according to their performed type of tasks, a different approach is chosen by taking all seven levels of the Likert Scale into account and receive a spectrum. To see how the satisfaction with the noise level, the type of task performed and the other questionnaire items concerning noise-related topics are connected, a correlation matrix is calculated in *Figure 16*.

	Simple/cognitive demanding tasks	Satisfaction with noise in the workplace	Noise is distracting	Tasks take longer when there is noise
Simple/cognitive demanding tasks	1	-0.18	0.22	0.13
Satisfaction with noise in the workplace	-	1	-0.48	-0.32
Noise is distracting	-	-	1	0.58
Tasks take longer when there is noise	-	-	-	1

Figure 16: Correlation matrix between simple/cognitive demanding tasks and all other noise-related items in the questionnaire

From *Figure 16* we can see that the two questionnaire items “I feel, when there is a lot of noise in the office, it takes me longer to perform a task” and “Noise in the office is distracting me from my tasks” show a relatively strong positive correlation. This is self-explanatory that tasks take longer if the employee feels distracted by noise. Also, the second strongest correlation, showing a negative correlation between the questionnaire items “How satisfied are you with the noise level in your workspace?” and “Noise in the office is distracting me from my tasks.” is rather straight forward, since employees who feel like noise is distracting them from their tasks, are less likely satisfied with the noise level in their office environment.

Contradicting the expectation in hypothesis 5, the type of task, simple or demanding, only yields a very low negative correlation towards the satisfaction with noise in the workspace, therefore implicating that the type of task is not a very strong factor when considering the employees' satisfaction level with noise in the office environment.

To better understand what influences the satisfaction with noise in the office, since this is an important variable concerning the overall satisfaction level, I derived a linear model using the AIC backward selection algorithm. The linear regression model derived through the AIC is depicted in *Table 12*.

	Estimate	Std.Error	t-value	p-value
(Intercept)	3.71	1.86	1.99	0.052
Simple/cognitive demanding tasks	-0.41	0.22	-1.85	0.071
Noise is distracting	-0.50	0.21	-2.41	0.020
Kitchen for non-work related talks	-0.25	0.17	-1.47	0.148
Speech Privacy	0.26	0.16	1.64	0.107
Regular use of phone cells	0.20	0.13	1.57	0.124
Clear view of screen is uncomfortable	0.28	0.15	1.88	0.066
Rarely non-work related things in office	0.28	0.15	1.82	0.074
Take home office opportunity	0.21	0.11	1.88	0.066
Use areas outside the home base	-0.38	0.19	-1.99	0.052
Find a likeable spot	0.50	0.20	2.53	0.015
Sit at different spot everyday	0.27	0.20	1.34	0.186
Prefer private or cell office to open-plan	-0.23	0.16	-1.48	0.146
Adjusted R ²	0.5009			
Significance F-Test	0.0000016			

Table 12: Linear Regression model via AIC selection algorithm with noise satisfaction as dependent variable

From *Table 12* above one can see that two items from the questionnaire show a significant impact on the satisfaction with noise in the office by yielding a p-value < 0.05. These two items are “Noise in the office is distracting me from my tasks”, which already shows a correlation with satisfaction concerning noise in the office in *Figure 16*, and “I usually find a spot I like working at”. The second item has originally been meant to depict the impact on the employees by the workplace rotation due to no employee having a fixed spot. But, of course, noise can also be a decisive factor if an employee is satisfied with the chosen workstation or not. For example, if there are only spots available, where it is very noisy, the employee will most likely not be satisfied with the chosen spot.

Taking into account the analyses conducted above, hypothesis 5 must be rejected, since the influence of the type of task is not significant in *Table 12* (Simple/cognitive demanding tasks; p-value=0.071) and there is only a very weak negative correlation depicted in *Figure 16*. Thus, the influence on satisfaction with noise in the open-plan office environment stays subject to further research. Also, a number of statistical tests could not be performed due to the lack of data regarding employees performing simple tasks, which could also be addressed in further research. Moreover, it has to be considered that noise level is not an objective measure, but it is very closely connected to the employees’ perception of noise and the different effects it has on an individual employee. Not everyone reacts to noise in the same way, which makes this factor a sensitive matter to deal with in an organization from an employer perspective to guarantee a productive working environment for all of the organization’s employees.

4.2.7 Hypothesis 6 – Shortage of Available Workstations Increases Dissatisfaction

H6: Dissatisfaction with the rotation of the workplace is increased, if there is a shortage of workstations in the home base.

The below-stated *Figure 17* gives a visual overview of how satisfied or dissatisfied different employees are concerning the rotation of the workplace. For this hypothesis, the employees are further split into two groups, those who agree with a certain item and those who disagree, as already seen in previous hypotheses. Four questionnaire items, which are closely linked to the concept of workplace rotation, are therefore examined closer by viewing the employees' satisfaction levels with workplace rotation with respect to their agreement or disagreement with the corresponding item. Then, an evaluation takes place, if depending on the employees' answer to the items, their satisfaction levels concerning the rotation of the workplace differs.

The following items from the questionnaire which are relevant for the workplace rotation are therefore examined in detail below:

- 1) "When I come in the morning, there are a lot of different workplaces available that I can choose to work at."
- 2) "I like the concept of no fixed spots, so I can sit where my project needs are best met."
- 3) "I usually find a spot I like working at."
- 4) "I like sitting at a different spot every day."

Item 1 gives the best indication if there is a shortage of workplaces in the office and therefore directly measures the dependent variable of satisfaction with the workplace rotation.

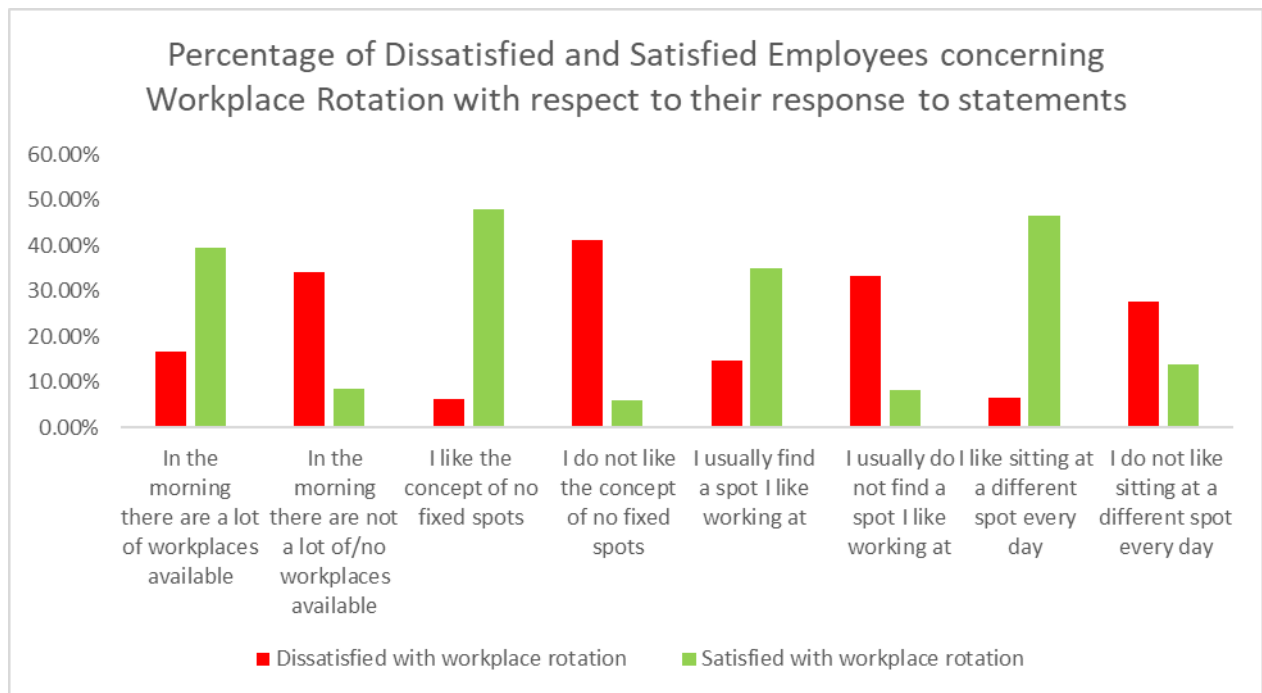


Figure 17: Satisfaction level for the rotation of the workplace, taking the employees' agreement or disagreement with related items in the questionnaire into account

When considering the first item, *Figure 17* clearly shows that employees, who feel like there are a lot of different workplaces available when they come in the morning, are significantly more satisfied than those who do not think that there are enough working spots available. This significant difference in satisfaction levels for the two employee groups is moreover confirmed by a p-value of 0.0029, which is retrieved from a Mann-Whitney-U-Test applied on the two groups concerning this item, separated by either agreeing or disagreeing with before-mentioned item.

Concerning the next item, which refers to the affinity of workplace rotation, *Figure 17* again shows a clear tendency, namely that people who like the concept of rotating workplaces are very satisfied concerning this topic, while people who do not like this concept, are very dissatisfied. The distinction between the two employee groups concerning the satisfaction level is the biggest one out of the above-mentioned items with a p-value of 0.0000.

Conducting a Mann-Whitney-U-Test for the third item, "I usually find a spot I like working at", yields a significant p-value of 0.0077, indicating that the employees agreeing and those disagreeing with the item differ here as well with statistical significance in their satisfaction levels concerning workplace rotation. This finding,

together with the bar chart in *Figure 17*, implicates that employees who find a spot they like working at are more satisfied than those who do not usually find a spot they like working at. An interesting aspect that is shown in *Figure 17* is, that out of the employees who state that they usually find a spot they like working at, still around 15% are dissatisfied with the rotation of the workplace.

The last item refers to the employees actually making use of the advantages of the rotating workplace principle and are really sitting at different spots from time to time. *Figure 17* indicates that those employees who use the working environment the way it was intended to and grasp the opportunity to sit at different workplaces every day are more satisfied with the rotation of the workplace than those who sit at the same spot every day. The significance of this finding is moreover supported by a p-value of 0.0016 from a conducted Mann-Whitney-U-Test on this specific item. When looking at the bar chart on the far right in *Figure 17*, it can be seen that for employees who do not like sitting at a different spot every day, there are still around 14% satisfied with the concept of workplace rotation.

Concluding from the analyses above, hypothesis 6 is supported by the gathered data. With high statistical significance, it is shown, that there is a big difference in satisfaction levels for workplace rotation between employees who agree with the items related to workplace rotation and those who disagree. Thus, employees who do not find a spot they like working at and employees who work in an area where there are no or little spots left when they arrive in the morning are less satisfied than the ones where the opposite occurs. Therefore, dissatisfaction is indeed increased if there is a shortage of workstations in the home base.

To moreover show the influence of the employees' agreement or disagreement with the above-mentioned items in relation to the satisfaction with the workplace rotation, a linear regression model with satisfaction of workplace rotation as the dependent variable and the items as independent variables are established.

Before deriving a linear regression model, a correlation matrix for the independent variables is computed and shown in *Table 13*, where one can see that the item "I like the concept of no fixed spots" and "I like sitting at a different spot every day" show a weak correlation. When performing a Spearman correlation test on the before-mentioned independent variables, the significance is supported by a p-value of 0.0000.

This correlation is reasonable since an employee who likes the concept of no fixed spots might also use it in the intended way and therefore enjoys sitting at different workstations.

	Workplaces available	Like the concept	Find a likeable spot	Like sitting at different spots
Workplaces available	-	0.220	0.448	-0.095
Like the concept	-	-	0.363	0.543
Find a likeable spot	-	-	-	0.011
Like sitting at different spots	-	-	-	-

Table 13: Correlation matrix for the above-mentioned items

The afterwards calculated linear regression model is calculated as the complete model, although *Table 13* might indicate multicollinearity between the two before-mentioned variables. Since only four independent variables are taken into consideration in the first place and also the backward elimination algorithm supports this initial model, the complete linear regression is shown in *Table 14* below.

	Estimate	Std. Error	t-value	p-value
(Intercept)	-0.27	0.67	-0.41	0.69
Workplaces available	0.27	0.13	2.06	0.04
Like the concept	0.50	0.15	3.29	0.00
Find a likeable spot	0.26	0.17	1.52	0.13
Like sitting at different spots	0.42	0.17	2.50	0.01
Adjusted R ²	0.38			
Significance F-Test	0.00			

Table 14: Linear regression model for satisfaction with workplace rotation as dependent and relevant items as independent variables

As shown in *Table 14*, the first item, which directly refers to the shortage of workplaces, is a significant variable in the linear model, meaning that it is indeed linked to the satisfaction level with workplace rotation and moreover significantly contributes to the before-stated linear regression model. This statistical model moreover supports the stated assumption in hypothesis 6 and leads to an overall support of the hypothesis, indicating that the shortage of workstations directly contributes to the dissatisfaction of the employees concerning satisfaction levels of workplace rotation.

4.3 Improvements for Already Existing Open-Plan Offices and Enhancing the Designing Process of such Environments

Besides the analysis of the hypotheses, a crucial part of my thesis is to point out smaller improvements that can be made in open-plan office environments in order to significantly enhance employee satisfaction.

In a first step, the questionnaire items which relate to improvements in open-plan offices are evaluated and then moreover supported and analyzed with the findings from the hypotheses in chapters 4.2.2 Hypothesis 1 until 4.2.7 Hypothesis 6.

The items on the questionnaire which refer to possible improvements in the office environment are stated as the following:

- 1) "I would like to have a separate office area, where it is more silent (e.g. no talking allowed, no phone calls allowed)."
- 2) "I would like to have more think tanks/meeting rooms in the home base for work discussions with colleagues."
- 3) "I would like to have more or higher partitions in the office."
- 4) "I would prefer a docking station for my laptop rather than plugging in everything separately (e.g. LAN cable, screen cable, charger)."

The following *Figure 18* shows how many employees agree or disagree with the above-mentioned items. When taking a look at the levels of agreement and disagreement in *Figure 18*, it becomes clear that the majority of employees wishes to see some improvements being made in the open-plan office setting. All of the below-mentioned items can be implemented quite easily and without huge costs. Therefore, an employer would be advised to consider the following suggestions for improvements, as indicated by the questioned employees, either already in the designing process of an open-plan office area or in a later stage via modifications applied in an already existing office. As clearly depicted in *Figure 18*, the majority of employees is dissatisfied with the current situation, and overall satisfaction will most likely be improved, if the employees' demand for improvements is met.

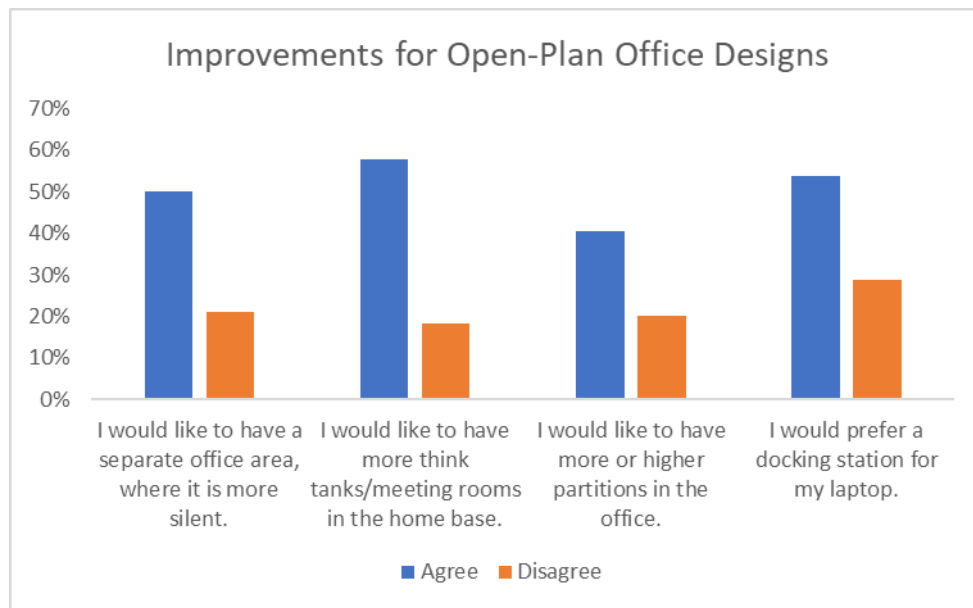


Figure 18: Percentage of employees who agree or disagree with items regarding possible improvements in open-plan office environments

4.3.1 Noise-related Improvements

The first two items are in relation to the disturbing factor of noise in the office. 50% of the employees would like to have a separated and silent working area, where they can conduct tasks in a quiet environment and are not disturbed by noise, such as irrelevant speech. Whereas only 21% do not see this improvement as a necessary one. This again points out the negative effect of noise in an open-plan working environment and that an area is needed, where employees can retreat to conduct more cognitively demanding tasks in a quiet environment. If such an environment is provided, employees will less likely be negatively impaired by noise, if they can decide to go to a different area and use a working space which offers noiseless working conditions if they are desired by an employee at a certain time. There are indeed some similar areas provided in the examined companies, which are called “focus areas”. But, said focus areas are located directly in the open-plan office without adequate physical separations, such as walls or doors, which would be sufficient to keep noise outside of this area, thus leading to an unsatisfactory working environment when looking for a quiet workplace. The only difference between the focus area and the rest of the office space is that the work stations located in the focus area have higher partitions surrounding the individual workplaces. Yet, as one can see from Figure 18 above,

employees do not seem to see such “focus areas” as sufficient solutions for a quiet working environment, but moreover wish for an actual silent space, where they can conduct cognitively demanding tasks without being impaired by noise.

The second item from the questionnaire, which is indirectly linked to noise, shows that the employees have a wish for more meeting rooms and more think tanks in the office environment. In the definition of the surveyed companies, think tanks are smaller meeting rooms which cannot be reserved or booked in advance and are therefore meant for spontaneous meetings, used by the employees for smaller discussions. Currently in the viewed companies, there are for every home base consisting of around 60 employees or more, two think tanks and 2 meeting rooms available. As visible in *Figure 18*, 58% of the questioned employees express the need for more think tanks and more meeting rooms, whereas only 18% do not see a need for more of the above-mentioned facilities. This item can be linked to noise, because due to a lack of think tanks and meeting rooms, employees will start discussing issues with colleagues directly at their desks. This will moreover create a noisy environment, involving the biggest disturbing noise factor, namely irrelevant speech, for their surrounding environment and thus negatively impact other colleagues, who are located closely to them, in their work. An increase of think tanks and meeting rooms can therefore lead to a rise in employee satisfaction caused by the immediate reduction of noise in the office environment, due to the fact that noise directly impacts the overall workplace satisfaction as we learned in chapter 4.2.2 Hypothesis 1. Thus, if employees are provided with the option to retract into a separate room when discussing topics with colleagues, which are not relevant for everyone in the office, in designated rooms, the overall workplace satisfaction will improve. An employer is therefore advised to implement more meeting rooms and think tanks in the office, since this does not involve high costs and will reduce noise permanently and therefore yield a long-term positive effect on the employees’ satisfaction in the office.

4.3.2 Privacy-related and Technological Improvements

As indicated by the empirical part of my thesis, the second big issue in the open-plan office environment, next to noise, is visual and sound privacy, or more accurately the lack thereof.

The third item from Figure 18 indicates that employees wish for more and/or higher partitions in the office area. 40% of the questioned employees agree with this item while only 20% do not agree. This shows a clear demand for more and/or higher partitions to create a higher privacy in the office environment. As seen in chapter [4.2.2 Hypothesis 1](#), visual privacy is an important factor for the employees in the open-plan office environment and thus directly influencing their overall workplace satisfaction. The demand for higher partitions should directly be acknowledged by an employer in the designing process of an open-plan office environment, for the reason that replacing every partition in the open-plan office would be very costly and therefore the additional costs might outrank the gained satisfaction levels due to a higher visual privacy. While the number of partitions can as well easily be enhanced also in an existing open-plan office environment. For the additional introduction of partitions, it would be best to directly involve the employees who are working in this office space in the improvement process to make sure the needs of the employees are really met.

The fourth item refers to a problem, which is generated by the rotation of the workplace. Since no employee has their fixed workstation, the working equipment, such as laptop, keyboard, mouse, LAN cable, charger and headset, have to be established every morning and removed every evening, and then stored in a designated locker. This can be very cumbersome to do this every day, considering there also might be meetings where the laptop with all the rest of the equipment is required and therefore has to be taken along, leading to the before-mentioned procedure being repeated more times in the course of the day. Therefore, 54% of employees agree with item number four and would prefer a docking station instead of plugging everything in separately, while only 29% of the employees do not consider this improvement to be necessary. This enhancement might be the most costly and laborious out of the four mentioned items, because the introduction of a docking station would require consistency in the used IT equipment, which is usually not the case. Employees with very old or defect laptops

might get a new replacement, while others still have older hardware, thus the plugs are different, depending on the model, and a single, identical docking station cannot be used. This complicates the introduction of docking stations, since different types of stations have to be used or some kind of adapter units. Therefore, an employer has to consider carefully how much added value docking stations would deliver, since there is no data available in my thesis to find out how technical improvements would affect the overall workplace satisfaction of employees in an open-plan office environment.

Overall it can be said that the employer always has to weigh the advantages against the disadvantages, considering how much the overall employee satisfaction would rise when conducting the before-mentioned improvements which were desired by the employees. And also, possible interdependencies have to be considered, since one improvement could have an effect on other relevant factors in the open-plan environment. For example, the introduction of more and higher partitions could improve visual privacy but might reduce the ease of interaction in return. Thus, one always has to keep in mind that changes made to the environment may lead to unwanted consequences.

5 Conclusion

The open-plan office environment is a very complex topic since employers' and employees' needs seem to drift apart sometimes. When taking a look at existing research towards this topic, the employer does not seem to always have the employees' best interest in mind, when referring to the implied negative factors that come with the introduction of open-plan offices, which might be overshadowed by the short-term cost savings an employer can gain. On the other hand, although there are obvious shortcomings in an open-plan office environment, like the omnipresence of noise as well as the clear lack of visual and sound privacy, this does not seem to affect the overall employee satisfaction too much, when considering the results from the questionnaire, where only around 5% of the employees stated that they are overall dissatisfied with their working environment.

The main message I want to transport via my thesis is that there is no perfect working environment that fits everyone's needs. As seen by testing various hypotheses there turned out to be deviations from anticipated results, where one would not expect them and the other way around. For example, cognitive-demanding and simple tasks do not seem to have an impact on satisfaction with noise, as the literature would have suggested. But on the other hand, office areas within the organization, which are built the exact same way and should therefore provide the same conditions for every employee, differ a great deal in the employee satisfaction concerning various factors in open-plan offices. This moreover suggests, that a company should know the needs of their employees within certain departments, since they might differ from one another. Therefore, employees who need to be creative in their work and prioritize communication within their team might need a different office environment than people who handle sensitive data and need undivided attention for their analyses. But not only the immanent tasks should be taken into account when designing the open-plan office, but also the circumstance that employees are individual human beings with different needs and requirements in order to feel satisfied in their working environment. A good example for the different needs of employees is the perception of existing noise in the workplace, whereas some employees are more sensitive to the presence of noise and get easier distracted by it than others. This moreover implies that companies should not only consider the performed tasks when designing a working area for a department, but also keep in mind that some employees might have different needs than others

and therefore, for example, allow for adjustments in the office made by employees so that they can adapt themselves appropriately depending on the current situation.

There are also rather simple ways to enhance the working conditions and employee satisfaction in an open-plan office environment, which were suggested by the employees taking part in my survey, such as the introduction of higher or more partitions in the office, a docking station for the laptop and more meeting rooms offering a possibility to retract and find a quiet workplace. By these rather convenient enhancements, employee satisfaction could already rise by a great deal.

There are as well some limitations to my work, such as insufficient data when it comes to certain aspects like the share of only 10% of part-time employees or the lack of questioned employees performing simple tasks. Therefore, my thesis can be used as a starting point for further research enhancing hypotheses by bigger data samples and therefore yielding a better ratio between the tested groups of employees with different characteristics. Also, my thesis only took into account two companies, which are based in Vienna and operate in the banking sector. Therefore, it is not possible to generalize my results in any way and it would be necessary to expand the data collection to other geographical and industrial areas as well to do so.

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7 Annex

7.1 Abstract

This thesis is trying to give a well-rounded picture of open-plan office environments with a focus on employee satisfaction and what factors are most crucial in ensuring before-mentioned well-being. The main influence factors are identified as noise, mainly irrelevant speech, and the lack of visual and sound privacy. Furthermore, through the distribution of questionnaires in two Vienna-based companies, and the analysis of those, insights concerning the influence of socioeconomical factors, organizational culture and workplace rotation are gained. This thesis can serve as a guidance for companies by supplying practical solutions as well as a starting point for further research concerning open-plan environments, improvement of those and a more sophisticated analysis of the depicted issues.

7.2 Zusammenfassung

Diese Arbeit befasst sich mit Open-Plan Bürostrukturen, und versucht dabei ein möglichst umfassendes Bild über diese abzuliefern, wobei der Fokus besonders auf die Mitarbeiterzufriedenheit, als auch auf die Faktoren, welche die zuvor genannte Zufriedenheit am meisten beeinflussen, gelegt wird. Als die bedeutendsten Faktoren wurden Lärm, vor allem irrelevante Gespräche, und das Fehlen von visueller und auditiver Privatsphäre identifiziert. Weiters wurden durch die Verteilung von Fragebögen in zwei Unternehmen mit Standorten in Wien, und der Auswertung dieser, wertvolle Erkenntnisse gewonnen in Bezug auf den Einfluss sozioökonomischer Faktoren, der Organisationskultur und dem Prinzip der Arbeitsplatzrotation. Diese Arbeit kann sowohl mit praktischen Lösungen als Leitfaden für Unternehmen dienen, als auch ein wertvoller Startpunkt für weitere Forschungen in Bezug auf Open-Plan Bürostrukturen, deren Verbesserungen und tiefergehende Analysen der dargestellten Probleme sein.

7.3 Questionnaire

Questionnaire – Open Space

The questions and statements on the following pages concern workplace satisfaction in open space office configurations and possible improvements that could be implemented. The purpose of this survey is to support existing results in this field as well as gain new insights in this topic. The results will be included in the empirical part of my master thesis in an anonymized form.

In the beginning of the questionnaire, personal information is entered to gain better insights concerning workplace satisfaction and social factors (age, gender,...) and therefore improve the survey.

Personal Information:

Gender: ☐ Male ☐ Female

Age: _____

Position: ☐ Intern ☐ Regular Employee ☐ Managing Position ☐ External or Leasing Worker

Working Hours: ☐ Part-time ☐ Full-time

Department: _____

Workplace Satisfaction

Please answer the following questions by marking what fits your opinion best. The range for your answer reaches from very dissatisfied to very satisfied. Having a neutral position towards these questions is also possible.

	Very Dissatisfied	Dissatisfied	Mildly Dissatisfied	Neutral	Mildly Satisfied	Satisfied	Very Satisfied
How satisfied are you with the temperature in your workspace?	☐	☐	☐	☐	☐	☐	☐
How satisfied are you with the air quality in your workspace (i.e. stuffy/stale air, odors)?	☐	☐	☐	☐	☐	☐	☐
How satisfied are you with the amount of light in your workspace?	☐	☐	☐	☐	☐	☐	☐
How satisfied are you with the visual comfort of the lighting (e.g., glare, reflections, contrast)?	☐	☐	☐	☐	☐	☐	☐
How satisfied are you with the noise level in your workspace?	☐	☐	☐	☐	☐	☐	☐
How satisfied are you with the sound privacy in your workspace (ability to have conversations without your neighbors overhearing and vice versa)?	☐	☐	☐	☐	☐	☐	☐
How satisfied are you with the amount of space available for individual work and storage?	☐	☐	☐	☐	☐	☐	☐
	Very Dissatisfied	Dissatisfied	Mildly Dissatisfied	Neutral	Mildly Satisfied	Satisfied	Very Satisfied
How satisfied are you with the rotation of your workplace every day/not having a fixed spot for yourself?	☐	☐	☐	☐	☐	☐	☐
How satisfied are you with the level of visual privacy?	☐	☐	☐	☐	☐	☐	☐
How satisfied are you with the ease of interaction with co-workers?	☐	☐	☐	☐	☐	☐	☐
How satisfied are you with the comfort of your office furnishings (chair, desk, computer, equipment, etc.)?	☐	☐	☐	☐	☐	☐	☐
How satisfied are you with your ability to adjust your furniture to meet your needs?	☐	☐	☐	☐	☐	☐	☐

How satisfied are you with the colors and textures of flooring, furniture and surface finishes?	☐	☐	☐	☐	☐	☐	☐
How satisfied are you with general cleanliness of the overall building?	☐	☐	☐	☐	☐	☐	☐
How satisfied are you with cleaning service provided for your workspace?	☐	☐	☐	☐	☐	☐	☐
How satisfied are you with general maintenance of the building?	☐	☐	☐	☐	☐	☐	☐
All things considered, how satisfied are you overall with your personal workspace?	☐	☐	☐	☐	☐	☐	☐

Open Space Specific Factors

Please evaluate the following statements concerning the most relevant factors while working in an open space office environment by how much you agree or disagree with them. The possible ratings are: strongly disagree, disagree, neither agree nor disagree, agree and strongly agree.

	Strongly Disagree	Disagree	Neither agree nor disagree	Agree	Strongly Agree
The majority of tasks I have to perform during a workday are cognitive demanding tasks and I have to focus and concentrate in order to perform well.	☐	☐	☐	☐	☐
Noise in the office (e.g. other co-workers talking, telephones ringing) are distracting me from my tasks.	☐	☐	☐	☐	☐
I feel, when there is a lot of noise in the office, it takes me longer to perform a task.	☐	☐	☐	☐	☐
I would like to have a separate office area, where it is more silent (e.g. no talking allowed, no phone calls allowed).	☐	☐	☐	☐	☐
I would like to have more think tanks/meeting rooms in the homebase for work discussions with colleagues.	☐	☐	☐	☐	☐
I understand the purpose of open space office concepts and why they are used.	☐	☐	☐	☐	☐
When I talk to a colleague about non-work-related things I prefer to go to the kitchen instead of talking in the office.	☐	☐	☐	☐	☐
I usually clear my desk when I am not using it for more than 3 hours.	☐	☐	☐	☐	☐
	Strongly Disagree	Disagree	Neither agree nor disagree	Agree	Strongly Agree
When I come in the morning, there are a lot of different workplaces available that I can choose to work at.	☐	☐	☐	☐	☐
When I want to work concentrated, I choose to sit at a focus area (higher walls, cubicle-like).	☐	☐	☐	☐	☐
I feel like I can have confidential conversations with colleagues in the office without others overhearing them.	☐	☐	☐	☐	☐
I often overhear other colleagues talking due to the office layout.	☐	☐	☐	☐	☐
I regularly use the provided phone cells to make phone calls.	☐	☐	☐	☐	☐
I feel like I can have confidential phone conversations in the phone cells.	☐	☐	☐	☐	☐
I feel uncomfortable when co-workers walk by and have a clear view of my screen.	☐	☐	☐	☐	☐
I rarely do non-work-related things in the office.	☐	☐	☐	☐	☐
	Strongly Disagree	Disagree	Neither agree nor disagree	Agree	Strongly Agree
I would like to have more or higher partitions in the office.	☐	☐	☐	☐	☐
The work I am doing usually requires a desk and a screen.	☐	☐	☐	☐	☐
I feel that I can be more creative in an open office configuration.	☐	☐	☐	☐	☐
I take the opportunity to do home office once a month or more often.	☐	☐	☐	☐	☐
I use different areas outside my homebase for working regularly (e.g. terrace, Café, etc.)	☐	☐	☐	☐	☐
I see the opportunity of doing home office as a needed compensation for the open office layout.	☐	☐	☐	☐	☐
I like the concept of no fixed spots, so I can sit where my project needs are best met.	☐	☐	☐	☐	☐
I usually find a spot I like working at.	☐	☐	☐	☐	☐

	Strongly Disagree	Disagree	Neither agree nor disagree	Agree	Strongly Agree
I like sitting at a different spot every day.	☐	☐	☐	☐	☐
I would prefer to work in a private office or cell office (up to 4 people) rather than in an open space office.	☐	☐	☐	☐	☐
I would prefer a docking station for my laptop rather than plugging in everything separately (e.g. LAN cable, screen cable, charger).	☐	☐	☐	☐	☐
I take my time in the morning to adjust my chair, desk and screen to my personal preferences.	☐	☐	☐	☐	☐
I use the possibility to work while standing up sometimes.	☐	☐	☐	☐	☐
I regularly have back or neck pain.	☐	☐	☐	☐	☐
Only if you have worked in a private office or cell office (up to 4 people in an office) before, otherwise leave empty: I prefer working in an open space office over working in the above-mentioned office types.	☐	☐	☐	☐	☐

7.4 Other Tables

7.4.1 Complete list of p-values for all items (in chronological order) from part two and part three of the questionnaire to compare values between home bases (p-values under 0.05 are highlighted)

For an easier readability, the clustered departments have been substituted by letters. The department key is the following:

A	Controlling (Company 2)
B	Market Risk Management
C	Non-Financial Risk/Compliance
D	IT
E	Controlling (Company 1)
F	ICAAP/Stress Testing

Questionnaire Item Number	A vs. B	A vs. C	A vs. D	A vs. E	A vs. F	B vs. C	B vs. D	B vs. E	B vs. F	C vs. D	C vs. E	C vs. F	D vs. E	D vs. F	E vs. F
1	0.713	0.163	0.234	0.508	0.155	0.180	0.106	0.228	0.053	0.012	0.032	0.008	0.467	0.761	0.304
2	0.175	0.017	0.245	0.675	0.343	0.345	1.000	0.369	0.811	0.553	0.039	0.358	0.320	0.856	0.465
3	0.739	0.147	0.683	0.972	0.507	0.160	0.842	0.904	0.549	0.250	0.262	0.035	0.942	0.290	0.385
4	0.447	0.505	0.836	0.759	0.593	0.182	0.452	0.331	0.976	0.621	0.649	0.359	0.960	0.599	0.503
5	0.364	0.206	0.414	0.775	0.658	0.434	0.156	0.141	0.373	0.070	0.043	0.217	0.782	0.966	1.000
6	0.847	0.369	0.673	0.179	0.556	0.226	0.827	0.353	0.612	0.232	0.019	0.214	0.582	0.800	0.821
7	0.102	0.978	0.821	0.130	0.925	0.058	0.102	0.714	0.298	0.794	0.077	0.898	0.131	0.736	0.371
8	1.000	0.313	0.545	0.793	0.950	0.248	0.531	0.776	0.835	0.097	0.152	0.618	0.646	0.579	0.734
9	0.532	0.755	0.436	0.233	0.477	0.230	0.733	0.485	0.248	0.141	0.055	0.686	0.907	0.190	0.192
10	0.433	0.340	0.355	0.580	0.374	1.000	0.957	0.761	0.730	0.923	0.716	0.774	0.701	0.888	0.554
11	0.513	0.713	0.384	0.971	0.252	0.749	0.070	0.447	0.378	0.132	0.671	0.283	0.233	0.040	0.153
12	0.686	0.853	0.694	0.679	0.974	0.826	0.960	0.231	0.725	0.813	0.368	0.893	0.330	0.758	0.603
13	0.882	0.478	0.649	0.408	0.949	0.468	0.477	0.346	0.928	0.185	0.766	0.741	0.147	0.611	0.623
14	0.088	0.065	0.193	0.113	0.054	0.902	0.980	0.942	0.282	0.854	0.916	0.351	0.960	0.323	0.271
15	0.066	0.023	0.291	0.123	0.030	0.615	0.459	0.567	0.240	0.296	0.316	0.476	0.741	0.158	0.121
16	0.010	0.032	0.493	0.066	0.052	0.748	0.171	0.637	0.300	0.349	0.884	0.418	0.422	0.212	0.353
17	0.460	0.864	0.356	0.145	0.900	0.234	0.707	0.336	0.732	0.207	0.056	0.913	0.686	0.608	0.418
18	0.165	0.545	0.511	0.013	0.176	0.463	0.785	0.128	0.719	0.846	0.040	0.392	0.182	0.646	0.423
19	0.294	0.139	0.911	0.761	0.327	0.657	0.267	0.430	0.039	0.091	0.173	0.007	0.733	0.277	0.162
20	0.892	0.453	0.151	0.839	0.034	0.303	0.094	0.971	0.018	0.308	0.272	0.057	0.091	0.384	0.020
21	0.421	0.234	0.045	0.083	0.086	0.827	0.247	0.640	0.355	0.251	0.778	0.382	0.228	0.899	0.405
22	0.026	0.002	0.010	0.006	0.057	0.364	0.557	0.549	0.879	0.801	0.796	0.523	0.962	0.633	0.622
23	0.938	0.654	0.957	0.646	0.346	0.470	0.759	0.609	0.259	0.686	0.239	0.108	0.444	0.158	0.522
24	0.445	0.749	0.552	0.171	0.358	0.545	0.129	0.353	0.615	0.289	0.155	0.379	0.037	0.155	1.000
25	0.402	0.546	0.193	0.901	0.443	0.440	0.375	0.288	1.000	0.269	0.559	0.811	0.174	0.710	0.506
26	0.434	0.068	0.549	0.398	0.111	0.202	0.066	0.038	0.176	0.009	0.002	0.604	0.859	0.025	0.016
27	0.984	0.699	0.105	0.882	0.222	0.551	0.023	0.787	0.106	0.048	0.749	0.201	0.030	0.764	0.142
28	0.940	0.934	0.349	0.928	0.658	0.978	0.230	0.883	0.455	0.328	1.000	0.489	0.224	0.231	0.447
29	0.045	0.010	0.738	0.448	0.568	0.271	0.018	0.180	0.008	0.004	0.028	0.004	0.280	0.762	0.142
30	0.047	0.399	0.633	0.032	0.091	0.404	0.381	0.808	0.830	0.777	0.525	0.812	0.495	0.762	0.976
31	0.646	0.613	0.119	0.571	0.567	0.303	0.058	1.000	0.379	0.261	0.259	0.860	0.037	0.521	0.330
32	0.639	0.371	0.649	0.914	0.778	0.083	0.280	0.176	0.850	0.749	0.368	0.300	0.923	0.437	0.477
33	0.071	0.417	0.116	0.499	1.000	0.335	0.761	0.223	0.038	0.338	0.873	0.473	0.247	0.116	0.444
34	0.878	0.497	0.774	0.692	0.846	0.492	0.821	0.533	0.708	0.765	0.250	0.385	0.529	0.632	0.977
35	0.047	0.530	0.949	0.261	0.304	0.059	0.078	0.311	0.581	0.623	0.444	0.481	0.340	0.385	0.877
36	0.880	0.803	0.022	0.499	0.374	0.651	0.005	0.471	0.357	0.028	0.311	0.250	0.004	0.003	0.861
37	0.471	0.000	0.035	0.012	0.027	0.000	0.080	0.022	0.049	0.081	0.158	0.770	0.594	0.374	0.489
38	0.160	0.543	0.048	0.954	0.664	0.213	0.623	0.042	0.272	0.057	0.357	0.964	0.008	0.105	0.515
39	0.043	1.000	0.120	0.486	0.356	0.052	0.535	0.158	0.588	0.129	0.551	0.398	0.462	0.928	0.667
40	0.836	0.404	0.142	0.681	0.975	0.700	0.056	0.986	0.759	0.036	0.712	0.621	0.051	0.266	0.771
41	0.648	0.175	0.933	0.853	0.236	0.304	0.540	0.624	0.261	0.149	0.131	0.817	0.800	0.140	0.089
42	0.268	0.299	0.488	0.899	0.097	0.818	0.826	0.265	0.463	0.986	0.319	0.245	0.480	0.437	0.059
43	0.168	0.603	0.022	0.050	0.412	0.502	0.173	0.469	0.976	0.067	0.207	0.780	0.457	0.395	0.731
44	0.468	0.900	0.818	0.263	0.465	0.405	0.589	0.366	0.611	0.708	0.185	0.391	0.419	0.608	0.932
45	0.316	0.340	0.217	0.209	0.064	0.788	0.719	1.000	0.184	0.479	0.667	0.083	0.626	0.324	0.086
46	0.168	0.912	0.173	0.265	0.073	0.118	1.000	0.612	0.397	0.120	0.204	0.036	0.626	0.410	0.211
47	0.114	0.076	0.060	0.491	0.075	0.937	0.645	0.212	0.764	0.666	0.184	0.649	0.100	1.000	0.099
48	0.562	0.712	0.040	0.077	0.789	0.288	0.019	0.052	0.572	0.099	0.348	0.893	0.361	0.176	0.368