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Knowledge workers deserve differentiated offices and workplace facilities

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Purpose: This paper investigates factors that influence effective workplace designs for knowledge workers.
Design/methodology/approach: During spring 2016, the employees in a large Norwegian institution for research and higher education, a large consultancy company and a medium size consultancy company (in total 4367 employees) received invitations to participate in an anonymous online survey about workplaces and facilities. 1670 employees (38.2 per cent response rate) answered the survey. The data have been analysed with IBM SPSS version 23, among others through use of exploratory factor analysis and two-way ANOVA.
Findings: Most respondents at the institution for research and higher education have cell offices. Most respondents in the two consultancy companies have open and flexible offices. This study indicates the respondents' preferences or perception of their workstation and workplace's fit for their tasks is affected both by the respondents' type of office and how much time they spend at their workstation during the week.
Practical implications: The present research indicates that facility managers and others responsible for office and workplace design are advised to take the employees' work patterns into consideration when designing workplaces and providing offices and workstations to their end-users. The present research also indicates that employees require different kinds of support facilities depending on what kind of offices and workplaces they have.
Originality/value: This is a large N empirical study among knowledge workers in three organisations, one public administration and two private enterprises. The present research indicates that provision of offices and workstations with supporting facilities should be differentiated according to the end-users' work tasks and work patterns.

Keywords: ANOVA, Facility management, Knowledge workers, Norway, Survey, Workplace design.

Paper type: Research paper

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1 INTRODUCTION

Today, most industrialized countries are highly dependent of their knowledge workers' productivity. This paper is a study of how workplace design, facilities and services facilitate knowledge workers' ability to do their job. The European standard EN15221-1 defines Facilities Management (FM) as "Integration of processes within an organization to maintain and develop the agreed services which support and improve the effectiveness of its primary activities" (CEN, 2006). Application of FM ideas and principles is thus of high relevance for those who aim for workplaces that support and improve the effectiveness of organizations' primary activities; hereunder improving organizations' ability to achieve their goals through application of their knowledge workers' knowledge and skills. This explorative study of factors that are important for the knowledge workers' (the end-users') perceived productivity at their offices and workstations has been made in three Norwegian knowledge organizations, one institution for research and higher education and two consultancy companies.

2 LITERATURE

The last decades' development of ICT has made virtual workplaces far more common. However, physical offices are still the most common workplace for knowledge workers. This study emphasizes physical workplaces and offices.

There are several typologies of offices at workplaces. Jensen (2001, p. 129) distinguish between four main categories. The first is open landscapes; i.e. large rooms with several desks or workstations. The second category is cubicles or cell offices, usually for individual workers or small numbers of workers. The third category is group offices where employees are seated according to their organizational belonging. The final category is so-called activity-based offices with different zones and workstations that permit different kinds of work, ranging from individual concentration work to group work that require interaction and communication.

A very important question concerning workplaces, offices and workstations, is whether the employees have a personal desk or workstation at a particular office, or if the organization has implemented a shared space scheme through so-called flexible offices, combi-offices or hot-desking, where a department or team share a number of workstations (Jensen 2001, p.121; Booty 2009, p. 359; de Been and Beijer 2014). The most extreme concept of space sharing at workplaces is so-called free seating combined with a clean desk policy, where the organization's workstations are available across organizational boundaries. Flexible offices or hot-desking, i.e. fewer workstations than employees can save organizations for considerable space and even costs, particularly if the employees spend significant time at other places than their workstations. According to Booty (2009, p. 359), there are no rules of thumb for "the correct ratio" of desks or workstations to employees in hot-desking arrangements. The ratio is usually determined by how much time the employees spend other places, whether the employees can or are permitted to carry out their deskwork somewhere else, and whether the employees can use other departments' free desks or workstations if their own department's desks are occupied.

According to Haynes (2008), interaction and distraction significantly influence knowledge workers' office productivity. This is evident for individual process workers who spend less than 60 per cent of their time with colleagues, for group process workers who spend more than 60 per cent of their time with colleagues, and for those with concentrated study work who also spend less than 60 per cent of their time with colleagues (Haynes, 2008). Thus, the knowledge workers' balance between interaction and distraction is very delicate. Landscapes and group offices typically facilitate interaction but may also provide numerous opportunities for distractions. Cell offices limit the interaction between employees, but also limit distractions. Activity based offices often facilitate interaction, but may also facilitate or protect against distractions, depending on the design of the zones and workstations in question.

Organizations that replace traditional offices with free seating or hot-desking concepts usually have to compensate their employees by providing different kinds of facilities in addition to the traditional offices with desks or workstations (Booty, 2009, p. 352-353). Examples of such compensating measures and facilities are among others social zones or breakout areas with kitchenettes, coffee machines, coffee tables, sofas, etc. and various kinds of touchdown areas for those who don't need a workstation but only a place to read e-mails. Such compensation measures may also include different kinds of quiet areas, and even study boots to permit concentrated work, as well as meeting rooms. In most organizations, about two thirds of the meetings involve six persons or fewer, and approximately fifty per cent of the meetings involve four persons or fewer (Booty, 2009, p. 353). Thus, many organizations need few large meeting rooms, but several smaller meeting rooms. In organizations with open offices, small meeting rooms are often also used for phone calls, concentration work, etc. Replacement of traditional offices with free seating and hot-desking is often also compensated with an improved canteen or company restaurant, or facilities for physical exercises, etc. (Booty, 2009, p. 330 ff.)

A study of introduction of flexible offices at Delft University of Technology's Faculty of Architecture (N = 266) showed that the respondents were satisfied with their new flexible offices, because the new offices are not crowded. The workstations were functional and available, and facilitated informal meetings and conversations. However, there were limited possibilities for confidential phone conversations, "insufficient visual and auditory privacy", and few opportunities for control of the indoor environment. There were also respondents who questioned the security, because of open environments and few lockable doors. There were also limited possibilities for storage of personal and collective belongings. The flexible offices offered workstations designed for different tasks, but very few respondents changed workstation during the day. However, after introduction of flexible offices the average degree of working from home increased from 16 to 27 per cent of the week (Gorgievski et al., 2010). Thus, it was evident that introduction of flexible offices in an academic institution had pros and contras.

Based on ethnographic studies of 20 knowledge workers, Greene and Myerson (2011) derived four ideal types, depending on the knowledge workers' mobility and work patterns. The first ideal type was the "Anchor", the traditional office worker who is present at their desk every day. Anchors typically spend most of their time on concentration work, often in a noisy environment. The second ideal type is the "Connector", who typically spends half the workweek at different locations at the workplace in meetings, etc. Most Connectors are managers or coordinators. The third ideal type is the "Gatherer" who generates many relationships outside the office and spends approximately half the week away from the workplace. Gatherers typically get a shared desk. The last ideal type is the "Navigator", who occasionally visits her own office. Navigators are typically salespersons, contractors or consultants. Today, gatherers and navigators often use virtual workplaces.

In a study of 274 Dutch knowledge workers employed by 27 small and medium-sized enterprises, the physical work environment operationalised as furniture, indoor plants and flowers, colours, privacy, window views, light, daylight, indoor climate, sound and smell, was found to be less important for the knowledge workers' creativity than the knowledge workers' personality traits and the socio-organisational work environment (Dul et al., 2011). Thus, according to Dul et al. (2011), selection and recruitment of employees with a creative mind set and the organisation's leadership practices are more important for knowledge workers' creativity than the physical work environment.

Between 2007 and 2013, Delft University of Technology's Center for People and buildings (CfPB) have made 105 case studies of employees (N = 14,980) at 35 traditional offices with personal desks, 14 combi-offices with personal desks, 52 combi-offices with shared desk schemes, 2 open landscapes and 2 miscellaneous spaces. These studies indicate that about two thirds of the employees are reasonably satisfied with their organization, work and workspace. However, the employees are least satisfied with support for concentration, storage facilities, indoor climate and acoustics. A closer comparison between traditional offices and flexible offices with personal desks and offices where the employees don't have personal desks revealed that offices without personal desks often had better architectural qualities but were questionable concerning privacy and possibilities for concentration (van der Voordt et al. 2016).

These findings are very similar to de Been et al.'s (2015) findings based on 20 case studies (N = 2733 survey respondents and 57 group interviews (N = 271)). De Been et al. (2015) found that respondents with workstations in open areas were distracted by telephone calls and conversations. De Been et al. (2015) therefore recommended establishing meeting rooms or meeting areas next to the open workspaces. Some of these findings are rather similar to Gorgievski et al.'s (2010) findings after introduction of flexible offices at Delft University of Technology's Faculty of Architecture. Even Hills and Levy's (2014) study of a corporation in Auckland, New Zealand, that had been relocated to a centrally located flexible and open area type of office where the area per employee had been reduced from 15.7 square meters to 12.8 square meters, found that privacy, control and distractions from their colleagues' telephone conversations and computer screens and the opportunity to chat with the colleagues sitting next to them were some of the challenges facing the employees after moving in to the new office. However, Hills and Levy (2014) found the building's central location and geographical proximity to public transports and key clients partly offset the privacy, control and distraction issues.

Data from Leesman Office, a consultancy company that since 2010 has collected data about employees' satisfaction with their office environments, based on studies of 115 organizations at 370 different locations with all kinds of offices in five Western European countries (N = 47,913) indicate that employees are not satisfied with indoor climate and, privacy. Leesman Office's data also include some facilities services. In average, the employees are satisfied with coffee and tea, security and mail services, but they are not satisfied with hospitality services, leisure facilities, atriums and other common areas, according to van der Voordt et al. (2016).

Based on a study of Finnish knowledge workers (N = 1116) in the Helsinki Metropolitan Area, Rothe et al. (2011) found that in average respondents aged in their thirties and forties were more positive to restaurant services and environment that support collaboration than older respondents were. Thus, some of the employees' preferences may vary according to the respondents' age.

Based on data from Leesman Office, Appel-Meulenbroek et al. (2015) investigated whether employees with activity-based workplaces (so-called "NewWoW") had different opinions concerning workplaces compared to employees with traditional workplaces (so-called "TradWoW"). Based on t-tests of the respondents' answers (N = 43,791), Appel-Meulenbroek et al. (2015) found that employees with NewWoW were significantly more satisfied with office climate, office décor, office leisure, cleanliness and seclusion rooms, than employees with TradWoW. On the other hand, respondents with TradWowW compared to respondents with NewWoW were significantly more satisfied with general facilities, desk and chair, privacy, and storage.

This paper investigates the following research questions:

How do type of office and time spent at the workstation during the week influence:

- the knowledge workers' perception of their workstation's efficiency?
- the knowledge workers' perception of the workplace design effectiveness?
- the knowledge workers' perception of the common areas' importance?
- the knowledge workers' perception of the seclusion room's importance?
- the knowledge workers' perception of the canteen's importance?

How do type of office and age influence:

- the knowledge workers' perception of their workstation's efficiency?
- the knowledge workers' perception of the workplace design effectiveness?
- the knowledge workers' perception of the common areas' importance?
- the knowledge workers' perception of the seclusion room's importance?
- the knowledge workers' perception of the canteen's importance?

3 METHODS

Knowledge work is often intangible and thereby "difficult to map and assess" (Greene and Myerson, 2011). It is thus rather difficult to measure knowledge workers' productivity, and thereby the effect of different kinds of workplaces and interventions on workplaces (Ramirez and Nembhard, 2004; van der Voordt et al., 2016; de Been et al., 2016). One approach to overcome these challenges is to measure the "*perceived* (impact of facilities on) productivity" (de Been et al., 2016, p. 149). This approach was chosen in the present research. One possible alternative to measurement of the respondents' perceived productivity through a questionnaire survey, is an experiment where randomized experiment and control groups of respondents do similar tasks in different office environments and where the respondents' actual productivity is measured. However, such an experiment is difficult and most likely also rather costly to arrange. There are also most likely still several X-factors in the productivity equation, which are difficult to control even in experimental settings. Thus, the chosen approach of measuring the respondents' perceived productivity seems justified given the available time and resources.

In April and May 2016, all the 2517 employees in a large Norwegian institution for research and higher education, the 1672 employees in a large consultancy company and the 178 employees in a medium sized consultancy company received an e-mail invitation to participate in an anonymous online survey about workplaces and facilities at workplaces. The study was approved by NSD Norwegian Center for Research Data (permit no. 48312), who is The Norwegian Data Inspectorate's partner for implementation of the statutory data privacy requirements in the research community. 1670 respondents (1019 in the institution for research and higher education, 605 in the large and 46 in the medium sized consultancy company) answered the survey. A total response rate of 38.2 per cent is very good for this kind of survey in Norway. This sample is fairly representative for the employees in these three organizations.

The online questionnaire included questions about the building where the respondents' workplace is located (3 items) and whether the respondents could regulate the interior climate (4 items). This information is not used in this paper. The questionnaire also included questions about the respondent's physical workstation (4 items), and questions with a 10-point Likert scale about the respondents' perception or attitudes where 1 indicated no/very little degree and 10 indicated very high degree. The questions with the 10 point Likert scale were about lighting (5 items), temperature (5 items), ventilation (5 items), acoustics (5 items), workstation (6 items), seclusion rooms (6 items), meeting rooms (6 items), canteen (6 items), breakout areas (6 items), kitchenettes (6 items), social zones' influence (6 items), freedom of choice (6 items), access to facilities (6 items), and workplace design (6 items). Finally, the respondents got some demographic questions (gender, age group, position and length of service in their organization).

The survey data have been analysed with IBM SPSS version 23. The most important analytical methods have been descriptive statistics (frequency, mean, cross tables, etc.); exploratory factor analysis (EFA), and two-way ANOVA.

The questionnaire's reliability was tested through calculation of Cronbach's Alpha for each group of questions concerning perceptions or attitudes; i.e. those with a 10-point Likert scale from 1 = Not/No degree to 10 = Very much/Very high degree. The questionnaire's groups of questions with a 10-point Likert scale had acceptable reliability (Cronbach's alpha between .824 and .972), except the group Access to facilities which had a Cronbach alpha of .666. However, .666 is acceptable for an exploratory study (Hair et al., 2014, pp. 90, 123-125). Thus, the questionnaire's groups of questions with 10-point Likert scales have been included in the EFA.

The EFA is based on Maximum Likelihood (ML) factor extraction that maximise the canonical correlation between variables and factors (Tabachnick and Fidell, 2014, p. 689). Rotation of factor solutions simplifies the interpretation, and the EFA is based on Varimax rotation because orthogonal rotation usually provides clear separation of the factors; i.e. high or low factor loadings (Hair et al.,

2014, p. 110-120). All other things equal, clear separation between the factor loadings simplifies interpretation of the rotated solution.

The EFA was used to establish new composite variables (constructs); i.e. summated scales by adding variables loading on the same factors and calculating the mean score. Summated scales reduce measurement error and simplify identification of common factors (Hair et al., 2014, p. 122-125). Based on the factor analysis 12 constructs were established. These constructs are continuous and vary between minimum 1 and maximum 10 and are thus suitable for use as dependent variables in ANOVA models. Even these constructs' reliability has been tested through calculation of Cronbach's Alpha.

Analysis of variance (ANOVA) is usually applied on experimental data but can also be used for analysis of observational data, such as survey data (Iversen and Norpoth, 1987). ANOVA models test whether different groups or categories determined by one or more categorical (nominal level) independent variables have different means on a metric dependent variable. One-way ANOVA models have one independent variable. A one-way ANOVA model with a two-category independent variable is thus equivalent to a t-test. Two-way or higher order ANOVAs have two independent variables, and so forth. The main difference between a one-way ANOVA and two-way or higher order ANOVA models is that effects detected in two-way or higher order models can be decomposed into main effects (direct effects) from the independent variables, and interaction effect(s) between the independent variables (Iversen and Norpoth, 1987, pp. 38-43). The interaction effect means that the effect of one independent variable on the dependent variable is dependent of the effect of one or more of the other independent variables. Crossings or divergent lines in plots of the test results indicate interaction; parallel lines in the plots indicate absence of interaction (Coolican, 2014, pp. 601-606). One of the other main advantages by using two-way or higher order ANOVA rather than several one-way ANOVA models is that the effects of the dependent variables are "pulled out of the residual variable at the same time" (Iversen and Norpoth 1987, p. 46). Use of two-way of higher order ANOVA models may thus also reduce the risk for type 1 errors; i.e. reporting effects when there actually are no effects to report (Coolican, 2014, p. 601).

Five of the constructs, F5 Workstation efficiency, F7 Workplace design effectiveness, F1 Common areas, F4 Seclusion rooms and F6 Canteen have been analysed with two-way between-subjects factor ANOVA models, with one of the constructs as dependent variable and the categorical variables Type of office and Hours per week spent at the workstation and Type of office and Age group as independent variables (factors). The most elegant solution for controlling for the respondents' age would have been use of analysis of covariance (ANCOVA) with age as a covariate to control the respondents' age, instead of ANOVA (Tabachnick and Fidell, 2014, p. 236). However, this was not possible, because the survey only included questions about the respondents' age category, not the respondents' exact age.

To make the constructs more suitable for ANOVA, due to somewhat negatively skewed distributions (i.e. many high scores), the constructs have been through a squared (X^2) transformation to reduce the negative skew (Hair et al., 2014, pp. 71-77). These transformations expanded the constructs' scale from 1 to 10 to scale 1 to 100, and significantly improved the constructs' skewness and kurtosis. Thus, these transformations made the data better suited for two-way ANOVA. However, these transformations have not changed the constructs' interpretation. A high score still indicates better/more important than a low score, even if the transformed constructs' scales are far longer than in the questionnaire.

4 RESULTS

This section includes three subsections, the first about the respondents, the second about the EFA, and the last about testing two-way ANOVA models of the effect of the two independent variables Type of office and Hours spent at the workstation during the week on the dependent variables.

4.1 The respondents

1670 respondents answered the survey. 1019 in the institution for research and higher education (61.0 per cent), 605 in the large consultancy company (36.2 per cent) and 46 in the medium size consultancy company (2.8 per cent). There are 745 female (55.7 per cent) and 592 male respondents (44.3 per cent). 340 respondents did not reveal their gender. The respondents age distribution were 123 who are 29 years or younger (9.1 per cent), 286 between 30 and 39 years (21.2 per cent), 365 between 40 and 49 years (27.0 per cent), 336 between 50 and 59 years (24.9 per cent), and 241 60 years or older (17.8 per cent). 326 respondents did not reveal their age. Table 1 presents an overview of the respondents and where they are seated at their workplace.

< Please insert Table 1 (Respondents' offices) approximately here >

Approximately 90 per cent (850) of the respondents employed by the institution for research and higher education have cell offices with reserved position or workstation. Most respondents in the two consultancy companies have flexible offices with reserved positions or workstations. Very few respondents (50) have flexible offices with free seating or hot-desking. Most of these are actually employed by the institution for research and higher education.

How about the respondents' sharing of office? 1505 respondents informed about office sharing. In the institution for research and higher education, 663 respondents (73.4 per cent) had their own office. 158 (17.5 per cent) shared office with 1-3 colleagues. 41 (4.5 per cent) with 4-10 colleagues, 15 (1.7 per cent) with 11-20 colleagues, and 26 (2.9 per cent) shared office with more than 20. In the large consultancy company, 173 respondents (30.9 per cent) had their own office. 37 (6.6 per cent) shared office with 1-3 colleagues, 90 (16.1 per cent) with 4-10 colleagues, 89 (15.9 per cent) with 11-20 colleagues, and 171 (30.5 per cent) shared office with more than 20. In the medium size consultancy company 4 respondents (9.5 per cent) had their own office. 6 (14.3 per cent) shared office with 1-3 colleagues, while 20 (47.6 per cent) shared office with 4-10 colleagues. 10 (23.8 per cent) shared office with 11-20 colleagues and 2 (4.8 per cent) shared office with more than 20. Thus, 840 (55.8 per cent) respondents had their own office, while 201 (13.4 per cent) shared office with 1-3 colleagues, 151 (10.0 per cent) shared office with 4-10, 114 (7.6 per cent) shared office with 11-20 and 199 (13.2 per cent) shared office with more than 20 colleagues. Most respondents in the two consultancy companies shared office with four or more of their colleagues.

< Please insert Table 2 (Respondents' weekly use of their workstations) approximately here >

Table 2 shows that technical/administrative employees at the institution for research and higher education spend more time at their workstations than researchers and teachers do. This seems reasonable, since teachers and researcher spend a lot of time in auditoriums or classrooms, in libraries or in the field collecting data. In the two consultancy companies, administrators and project staffs spend

most of their week at their workstations, while managers seem to spend considerable time in meetings, etc.

4.2 Exploratory factor analysis

EFA with Maximum Likelihood extraction and Varimax rotation gave 13 factors. The 13th factor was not established as a construct because of low factor loadings (< .30) and unacceptable reliability (Cronbach's alpha < .60). The remaining factors became the basis for 12 constructs (additive composite variables). Table 4 show the factors/constructs in diminishing order according to the factor loadings.

< Please insert Table 3 (Factors and constructs) approximately here >

Table 3 also show the results of the reliability tests of the constructs based on the factors derived. All the 12 factors/constructs derived have acceptable reliability (Cronbach's alpha > .70). The factors/constructs of relevance for this paper are F1 Common areas, F4 Seclusion rooms, F5 Workstation efficiency, F6 Canteen and F7 Workplace design effectiveness. These factors are used as dependent variables in two-way between-subject factors ANOVA, but in a somewhat different order, starting with F5 Workstation efficiency, F7 Workplace design effectiveness, F1 Common areas, F4 Seclusion rooms, and finishing with F6 Canteen.

The four items in F5 Workstation efficiency are questions concerning how the workstation supports the respondent's productivity, concentration, well-being and health. The three items in F7 Workplace design effectiveness are questions concerning how the workplace's design facilitates the respondent's collaboration and socialisation with colleagues, and well-being at the workplace. The eight items in F1 Common areas are questions concerning how areas near coffee machines and kitchenettes and other breakout areas facilitate the respondent's well-being, health, socialisation and collaboration with colleagues. The six items in F4 Seclusion rooms are questions concerning how seclusion rooms support the respondent's productivity, concentration, well-being, health, and collaboration and socialisation with colleagues. The five items in F6 Canteen are questions concerning how the canteen facilitates the respondent's well-being, collaboration with colleagues, health, and socialisation with colleagues, concentration, and productivity.

4.3 Two-way ANOVA

A two-way 3*4 (Type of office*Hours per week at the workstation) between-subject factors ANOVA showed that the main effects of Type of office ($F(2, 1262) = .163$, $p = .850$) and Hours per week spent at the workstation ($F(3, 1262) = .458$, $p = .711$) on F5 Workstation efficiency were not significant. However, the interaction effect between Type of office and Hours of week spent at the workstation on F5 Workstation efficiency was significant ($F(6, 1262) = 3.826$ $p = .001$). The interaction's effect size was small (partial $\eta^2 = .018$).

< Please insert Figure 1 (Scores on F5 Workstation efficiency given the respondents' type of office and hours per week at the workstation) approximately here >

A plot of the different categories of respondents' mean scores on F5 Workstation efficiency indicate that respondents who use their workstation less than 10 hours per week have high score on F5 Workstation efficiency if they have flexible offices with free seating (M = 78.88, SD =20.07, N = 3), medium high score if they have flexible offices (M = 53.13, SD = 27.63, N = 10) with reserved positions and low scores if they have cell offices with permanent positions (M = 39.34, SD = 24.26, N = 25). Respondents who use their workstation 1-20 hours per week have low score on F5 Workstation efficiency if they have flexible offices with free seating (M = 37.41, SD = 23.06, N = 6), and medium score on F5 Workstation efficiency if they have flexible offices with reserved position (M = 55.58, SD = 23.18, N = 30) or cell office with reserved position (M = 55.88, SD = 25.71, N = 122). Respondents who use their workstation 21-30 hours per week have almost similar score on F5 Workstation efficiency, no matter whether they have flexible office with free seating (49.62, SD = 22.84, N = 19) or flexible office with reserved position (M = 49.31, SD = 22.23, N = 81), and a somewhat higher score if they have cell office with reserved position (M = 56.23, SD = 27.01, N = 285). Respondents who use their workstation more than 30 hours per week have relative low score on F5 Workstation efficiency if they have a flexible office with free seating (M = 42.92, SD = 32.25, N = 13) and somewhat higher score if they have a flexible office with reserved position (M = 47.65, SD = 25.07, N = 244) or a cell office with reserved position (M = 60.65, SD = 24.33, N = 436). Thus, Figure 1 indicates that respondents who use the workstation less than 10 hours per week and have flexible offices with free seating have far higher scores on F5 Workplace efficiency than respondents with cell offices with reserved positions. The other respondents with cell offices with reserved positions seem to have slightly higher scores on F5 Workplace efficiency than respondents with flexible offices. These differences are most likely a result of the interaction between type of office and hours per week at the workstation.

A two-way 3*5 (Type of office *Age) two-way between-subject factors ANOVA showed that the main effects of Type of office on F5 Workstation efficiency ($F (2, 1203) = 12.625$, $p < .001$) was significant, but Age ($F (4, 1203) = .806$, $p = .521$) on F5 Workstation efficiency was not significant. Neither the interaction effect between Type of office and Age on F5 Workstation efficiency was significant ($F (7, 1203) = .670$ $p = .698$). The effect size for Type of office on F5 Workstation efficiency was small (partial $\eta^2 = .021$).

< Please insert Figure 2 (Scores on F5 Workstation efficiency given the respondents' Type of office and Age) approximately here >

Figure 2 indicates that respondents aged 50 or older with flexible offices have significantly lower score on F5 Workplace efficiency than respondents who have cell offices with reserved positions. Respondents younger than 50, have almost similar scores on F5 Workplace efficiency, no matter their type of office. This finding may indicate a possible generation effect concerning the respondents' perception of F5 Workplace efficiency.

A two-way 3*4 (Type of office*Hours per week at the workstation) between-subject factors ANOVA showed that the main effects of Type of office on F7 Workplace design ($F (2, 1248) = 8.295$, $p < .001$)

was significant but the effect size was small (partial η^2 = .013), even if the Hours per week at the workstation (F (3, 1248) = .656, p = .579) was not significant on F7 Workplace design effectiveness. The effect size of Hours per week was very small (partial η^2 = .002). The interaction effect between Type of office and Hours of week at the workstation was not significant (F (6, 1248) = 1.1718 p = .113), and the interaction's effect size was small (partial η^2 = .008).

< Please insert Figure 3 (Scores on F7 Workplace design effectiveness given the respondents' type of office and number of hours per week at the workstation) approximately here >

A plot of the results indicate that respondents who use their workstation less than 10 hours per week have very high scores on F7 Workplace design effectiveness if they have flexible offices with free seating (M = 91.48, SD = 9.65, N = 3), high scores if they have flexible offices (M = 71.24, SD = 24.58, N = 12) with reserved positions and medium scores if they have cell offices with permanent positions (M = 45.30, SD = 27.19, N = 24). Respondents who use their workstation 1-20 hours per week have medium high scores on F7 Workplace design effectiveness if they have flexible offices with free seating (M = 59.07, SD = 22.06, N = 6), flexible offices with reserved position (M = 64.11, SD = 24.01, N = 22) or cell office with reserved position (M = 55.75, SD = 26.96, N = 119). Respondents who use their workstation 21-30 hours per week have also almost similar scores on F7 Workplace design effectiveness, no matter whether they have flexible offices with free seating (65.57, SD = 23.81, N = 22), flexible offices with reserved position (M = 59.67, SD = 24.00, N = 81) or cell offices with reserved position (M = 57.27, SD = 23.40, N = 272). Respondents who use their workstation more than 30 hours per week also have medium scores on F7 Workplace design effectiveness if they have a flexible office with free seating (M = 63.71, SD = 32.24, N = 14), if they have a flexible office with reserved position (M = 62.13, SD = 25.16, N = 251) or a cell office with reserved position (M = 59.99, SD = 27.33, N = 434). Even these findings indicate that respondents with flexible offices with free seating who spend few hours per week at the workstation may be more satisfied with F7 Workplace design effectiveness than respondents with flexible offices or cell offices with reserved positions. However, there are small differences between perception of F7 Workplace design effectiveness among those respondents who spend more than 10 hours per week at the workstation, no matter the respondents' kind of office.

A two-way 4*5 (Hours per week spent at the workstation*Age) between-subject factors ANOVA showed that the main effects of Hours per week at the workstation on F7 Workplace design effectiveness (F (3, 1224) = 1.377, p = .248) was not significant and the effect size was very small (partial η^2 = .003). Even Age (F (4, 1224) = 1.344, p = .252) was not significant on F7 Workplace design effectiveness, and the effect size was also very small (partial η^2 = .004). The interaction effect between Hours of week at the workstation and Age on F7 Workplace design effectiveness was not significant (F (12, 1224) =.799 p = .652), and the interaction's effect size was thus small (partial η^2 = .008).

A 3*4 (Type of office*Hours per week at the workstation) two-way between-subject factors ANOVA showed that the main effects of Type of office on F1 Common areas (F (2, 580) = 8.037, p < .001) was highly significant but the effect size was relatively small (partial η^2 = .027). The Hours per week spent at the workstation (F (3, 580) = 1.176, p = .317) was not significant on F1 Common areas, and the effect size was small (partial η^2 = .006). The interaction effect between Type of office and Hours per week spent at the workstation was not significant (F (6, 580) = 1.368 p = .225), and the interaction's effect size was thus small (partial η^2 = .014).

< Please insert Figure 4 (Scores on F1 Common areas given the respondents' type of office and number of hours per week at the workstation) approximately here >

A plot of the results indicate that respondents who use their workstation less than 10 hours per week have medium to high score on F1 Common areas if they have flexible offices with free seating (M = 66.49, SD = 21.17, N = 3), high score if they have flexible offices (M = 92.92, SD = 12.26, N = 3) with reserved positions and relatively low scores if they have cell offices with permanent positions (M = 43.98, SD = 30.81, N = 10). Respondents who use their workstation 10-20 hours per week have medium score on F1 Common areas if they have flexible offices with free seating (M = 64.85, SD = 8.49, N = 3), flexible offices with reserved position (M = 61.97, SD = 28.96, N = 14) and somewhat smaller if they have cell office with reserved position (M = 48.67, SD = 29.48, N = 64). Respondents who use their workstation 21-30 hours per week have almost similar score on F1 Common areas, no matter whether they have flexible offices with free seating (M = 56.64, SD = 21.129, N = 6), flexible offices with reserved positions (M = 55.44, SD = 24.58, N = 38) or cell offices with reserved positions (M = 49.29, SD = 28.87, N = 146). Respondents who use their workstation more than 30 hours per week have high score on F1 Common areas if they have flexible offices with free seating (M = 82.50, SD = 24.06, N = 4), medium high if they have flexible offices with reserved positions (M = 55.88, SD = 25.80, N = 98), and somewhat lower scores if they have cell offices with reserved positions (M = 51.33, SD = 28.44, N = 203). Thus, respondents with cell offices with permanent positions have lower score on F1 Common areas than respondents with flexible offices. Respondents with cell offices most likely place less emphasis on common areas than respondents with flexible offices.

A two-way 3*5 (Type of office *Age) between-subject factors ANOVA showed that the main effects of Type of office on F1 Common areas (F (2, 563) = 3.158, p = .043) was significant, but Age (F (4, 563) = 1.497, p = .202) on F1 Common areas was not significant. Neither the interaction effect between Type of office and Age was significant (F (7, 1203) = .670 p = .698). The effect size for Type of office was small (partial η^2 = .021).

< Please insert Figure 5 (Scores on F1 Common areas given the respondents' type of office and age) approximately here >

A plot of the different categories of respondents' score on F1 Common areas given their type of office and age indicate an effect of office type, no matter the respondents' age. Respondents with flexible offices have higher scores on F1 common areas than respondents with cell offices with reserved positions. These findings are consistent across the age categories, except for respondents aged 40-49 who have almost similar scores on F1 Common areas no matter their type of office. Thus, common areas seem to be more important for respondents with flexible offices than for respondents with cell offices.

A two-way 3*4 (Type of office*Hours per week at the workstation) between-subject factors ANOVA showed that the main effects of Type of office on F4 Seclusion rooms (F (2, 588) = 6.031, p = .003) was significant but the effect size was relatively small (partial η^2 = .020). Hours per week at the workstation (F (3, 588) = .910, p = .436) was not significant on F4 Seclusion rooms, and the effect size

was also small (partial η^2 = .005). The interaction effect between Type of office and Hours of week at the workstation was not significant (F (6, 588) = .283 p = .945), and the interaction's effect size was also very small (partial η^2 = .003).

< Please insert Figure 6 (Scores on F4 Seclusion rooms given the respondents' type of office and hours per week at the workstation) approximately here >

Respondents who use their workstation less than 10 hours per week have relatively low scores on F4 Seclusion rooms if they have flexible offices with free seating (M = 46.99, SD = 32.12, N = 3), medium high scores if they have flexible offices with reserved positions (M = 65.04, SD = 27.86, N = 7) and lower scores if they have cell offices with permanent positions (M = 47.74, SD = 39.92, N = 8). Respondents who use their workstation 10-20 hours per week also have low scores on F4 Seclusion rooms if they have flexible offices with free seating (M = 29.95, SD = 19.75, N = 4), somewhat higher scores if they have flexible offices with reserved positions (M = 51.42, SD = 24.38, N = 21) and low scores if they have cell offices with reserved positions (M = 36.56, SD = 29.07, N = 37). Respondents who use their workstation 21-30 hours per week also have relatively low scores on F4 Seclusion rooms if they have flexible offices with free seating (M = 43.59, SD = 21.46, N = 14) and flexible offices with reserved positions (M = 50.05, SD = 22.07, N = 70) and even lower scores if they have a cell office with reserved position (M = 36.75, SD = 28.32, N = 91). Respondents who use their workstation more than 30 hours per week also have relatively low scores on F1 Common areas if they have a flexible office with free seating (M = 39.97, SD = 31.83, N = 11), but somewhat higher scores if they have flexible offices with reserved positions (M = 48.71, SD = 25.31, N = 194), and somewhat lower scores if they have a cell office with reserved position (M = 38.71, SD = 29.72, N = 140). Figure 6 indicate significant effects of type of office. F4 Seclusions rooms were also important for respondents who spend less than 20 hours per week at the workstation and for respondents with flexible offices and reserved seats. However, F4 Seclusions rooms seems to be less important for respondents with flexible offices with free seating or cell offices with permanent positions.

A two-way 3*5 (Type of office *Age) between-subject factors ANOVA showed that the main effects of Type of office on F4 Seclusion rooms (F (2, 565) = 9.993, p < .001) was significant, but Age (F (4, 565) = 1.694, p = .150) was not significant on F4 Seclusion rooms. Neither the interaction effect between Type of office and Age was significant (F (7, 565) = .189 p = .988). The effect size for Type of office was almost medium (partial η^2 = .034).

< Please insert Figure 7 (Scores on F4 Seclusion rooms given the respondents' office and age) approximately here >

Figure 7 indicates a significant effect of type of office. Figure 7 also indicates that respondents with flexible offices with free seating aged less than 29 and 50-59, and respondents of all ages with flexible offices with reserved seats have higher scores on F4 Seclusion rooms compared to respondents of all

ages with cell offices with reserved positions, and respondents aged 30-49 with flexible offices with free seating.

A two-way 3*4 (Type of office*Hours per week at the workstation) between-subject factors ANOVA also showed that the main effects of Type of office on F6 Canteen ($F (2, 847) = 16.418$, $p < .001$) was highly significant and the effect size was almost medium (partial $\eta^2 = .037$). However, Hours per week spent at the workstation ($F (3, 847) = .303$, $p = .823$) was not significant on F6 Canteen, and the effect size was minimal (partial $\eta^2 = .001$). The interaction effect between Type of office and Hours of week spent at the workstation was not significant ($F (6, 847) = 1.271$ $p = .268$), and the interaction's effect size was small (partial $\eta^2 = .009$).

Please insert Figure 8 (Scores on F6 Canteen given the respondents' type of office and hours per week at the workstation) approximately here >

A plot of the results even here indicate that F6 Canteen was most important for respondents with flexible offices and reserved seats, and relatively less important for respondents with flexible offices with free seating or cell offices with permanent positions. Respondents who use their workstation less than 10 hours per week have relatively low score on F6 Canteen if they have flexible offices with free seating ($M = 33.36$, $SD = 35.72$, $N = 3$), medium high score if they have flexible offices with reserved positions ($M = 65.54$, $SD = 30.58$, $N = 6$) and low scores if they have cell offices with permanent positions ($M = 22.57$, $SD = 18.96$, $N = 17$). Respondents who use their workstation 10-20 hours per week also have low score on F6 Canteen if they have a flexible office with free seating ($M = 16.00$, $SD = .00$, $N = 2$), somewhat higher score if they have flexible offices with reserved position ($M = 53.13$, $SD = 28.98$, $N = 22$) and relatively low score if they have a cell office with reserved position ($M = 37.38$, $SD = 27.96$, $N = 79$). Respondents who use their workstation 21-30 hours per week also have low score on F6 Canteen if they have a flexible office with free seating ($M = 24.18$, $SD = 18.27$, $N = 5$), a somewhat higher score if they have a flexible office with reserved position ($M = 44.91$, $SD = 24.07$, $N = 66$) and low score if they have a cell office with reserved position ($M = 31.97$, $SD = 26.72$, $N = 185$). Respondents who use their workstation more than 30 hours per week also have relatively low score on F6 Canteen if they have a flexible office with free seating ($M = 33.65$, $SD = 38.62$, $N = 5$), a somewhat higher score if they have a flexible office with reserved position ($M = 45.15$, $SD = 24.43$, $N = 192$), and somewhat lower score if they have a cell office with reserved position ($M = 33.93$, $SD = 26.71$, $N = 277$). Thus, the canteen is most important for respondents with flexible offices with reserved positions, no matter how many hours per week the respondents spend at the workstation.

A two-way 3*5 (Type of office *Age) between-subject factors ANOVA showed that the main effects of Type of office on F6 Canteen ($F (2, 822) = 18.925$, $p < .001$) was highly significant, while Age ($F (4, 822) = 2.307$, $p = .057$) was almost significant. The interaction effect between Type of office and Age on F6 Canteen was also almost significant ($F (7, 822) = 1.822$ $p = .069$). The effect size for Type of office on F6 Canteen was almost medium (partial $\eta^2 = .044$), but the effect sizes for Age (partial $\eta^2 = .011$) and interaction between Type of office and Age (partial $\eta^2 = .016$) on F6 Canteen were small.

< Please insert Figure 9 (Scores on F6 Canteen given the respondents' type of office and age) approximately here >

Figure 9 shows that respondents aged 29 or younger with flexible offices with free seating have highest scores on F6 Canteen, while respondents with flexible offices with reserved positions, no matter their age, have the second highest scores on F6 Canteen. Respondents with flexible offices with free seating aged between 30 and 59 have the lowest scores on F6 Canteen. Respondents with cell offices with permanent positions also have relatively low scores on F6 Canteen. Thus, the canteen seems to be most important for respondents with flexible offices with reserved positions. Maybe the canteen is very important for the respondents with flexible offices with reserved positions, because they have to maintain strict discipline during the day not to disturb their colleagues?

5 CONCLUSIONS

This paper has presented the results from an explorative large N survey (N = 1670) of knowledge workers' perception of different categories of offices and factors facilitating productive workplaces. The response rate of 38.2 per cent is good for this kind of survey in Norway. The respondents are fairly well representative for their organizations. 1053 respondents (67 per cent) had cell offices. 459 (29 per cent) had flexible offices with reserved positions, and 50 respondents (3 per cent) had flexible offices with free seating.

Analysis of the respondents' use of their workstations (c.f. Table 3), based on Greene and Myerson's (2011) framework revealed that most respondents were so-called anchors, who spent most of their time at their workstation. Many of the institution for research and higher education's technical and administrative staffs and researchers and teachers were so-called connectors. 33 per cent of the technical and administrative staffs and 32 per cent of the researchers and teachers used their workstations 21-30 hours per week. Even most top and many middle managers in the two consultancy companies used their workstations 21-30 hours per week.

This paper has investigated the following research questions, namely how do Type of office and Hours at the workstation during the week, and how do the respondents Type of office and Age influence the knowledge workers' perception of their workstation's efficiency, workplace design effectiveness, the importance of common areas, seclusion rooms and canteen? Two-way between-subject factors ANOVA of F5 Workstation efficiency, F7 Workplace design effectives, F1 Common areas, F4 Seclusion rooms and F6 Canteen revealed some interesting patterns.

First, concerning F5 Workstation efficiency, two-way between-subject factors ANOVA with Type of office and Hours per week at the workstation as independent variables, revealed that respondents who spend less than 10 hours per week at their workstations are most satisfied with flexible offices with free seating, and far less satisfied with flexible offices or cell offices with reserved positions. However, respondents spending more than 10 hours per week at their workstations seems to prefer cell offices with permanent positions. Cell offices with reserved positions may offer a better balance between interaction and disturbances than flexible offices. Haynes (2008) found that interaction and disturbances influence knowledge workers' productivity. Two-way between-subject factors ANOVA with Type of office and Age as independent variables revealed possible generation effects concerning F5 Workstation efficiency. Rothe et al. (2011) also indicated generation effects.

Second, concerning F7 Workplace design effectiveness, two-way between-subject factors ANOVA with Type of office and Hours per week at the workstation as independent variables, again indicated that respondents who spend less than 10 hours per week at the workstation prefer flexible offices with

free seating. However, the same analysis also revealed that the other respondents working 10-20, 21-30 or more than 30 hours per week at the workstation are almost indifferent to type of office when the question is workplace design effectiveness. Thus, supporting facilities and services seems to be of great importance for the respondents' perception of workplace design effectiveness. Two-way between-subject factors ANOVA with Type of office and Age as independent variables revealed no significant age effects concerning F7 Workplace design effectiveness, but Type of office had even in this model significant effects on F7 Workplace design effectiveness.

Third, concerning F1 Common areas, two-way between-subject factors ANOVA with Type of office and Hours per week at the workstation as independent variables, indicate that respondents who spend less than 10 hours per week at the workstation and who have flexible offices with reserved positions are far more concerned with common areas than respondents who spend more time at the workstation during the week. Those respondents who are least concerned with the common areas are those who have cell offices with permanent position. Thus, there is clearly a need for compensating measures if cell offices are replaced by flexible offices. The present research support findings in Leesman Office's studies (Appel-Meulenbroek et al., 2015; van der Voordt et al., 2016), which also indicated their respondents asked for common areas. The present research also indicates that common areas are of particular importance if cell offices are replaced by flexible offices. Two-way between-subject factors ANOVA with Type of office and Age as independent variables revealed no significant age effects of F1 Common areas.

Fourth, concerning F4 Seclusion rooms, two-way between-subject factors ANOVA with Type of office and Hours per week at the workstation as independent variables, indicate that respondents who have flexible offices with reserved positions have far stronger preferences for seclusion rooms than respondents who have flexible offices with free seating or cell offices with permanent positions. The two-way between-subject factors ANOVA also indicate that respondents who spend less than 10 hours per week at the workstation have stronger preferences for seclusion rooms than respondents who spend 10-20, 21-30 or more than 30 hours per week at the workstation. Thus, even these findings indicate a need for compensating measures if cell offices are replaced by flexible offices. Indoor climate, hereunder the acoustics is also important, such as indicated by Appel-Meulenbroek et al. (2015), de Been et al. (2015) and van der Voordt et al. (2016). Seclusion rooms can remedy acoustic challenges and facilitate concentration work in flexible offices, such as indicated by among others de Been et al. (2015). Two-way between-subject factors ANOVA with Type of office and Age as independent variables revealed age or possible generation effects concerning flexible offices with free seating and F4 Seclusion rooms.

Finally, concerning F6 Canteen, two-way between-subject factors ANOVA with Type of office and Hours per week at the workstation as independent variables, indicate a similar pattern as concerning F4 Seclusion rooms, namely that that respondents who have flexible offices with reserved positions have far stronger preferences for canteens than respondents who have flexible offices with free seating or cell offices with permanent positions, and that respondents who spend less than 10 hours and 10-20 hours per week at the workstation have stronger preferences for canteens than respondents who spend 21-30 or more than 30 hours per week at the workstation. Even these findings indicate the importance of compensating measures if cell offices are replaced by flexible offices. The canteen may be very important for those with flexible offices with reserved positions, who have to maintain a rather strict discipline during the day in order not to disturb their colleagues. A canteen can also facilitate informal meetings and concentration work if the canteen is accessible for the employees outside the canteen's peak hours. Two-way between-subject factors ANOVA with Type of office and Age as independent variables revealed age or possible generation effects concerning F6 Canteen. Even Rothe et al. (2011) found age or generation effects with regard to the respondents' preferences concerning canteen and restaurant facilities.

One methodical weakness in the present research is that two-way between-subject factors ANOVA has been applied on survey data. Experiments are usually arranged to provide almost equal numbers of observations in each category. This is usually not possible with survey data. The analysis could have

been based on 3*4*5 (Type of office*Hours per week at the workstation*Age) three-way between-subject ANOVA, but that would have given a large number of categories with very varying number of respondents. The use of 3*4 (Type of office*Hours per week at the workstation) and 3*5 (Type of office*Age) two-way between-subject factors ANOVA gave fewer categories with slightly more equal numbers of respondents, and thus most likely also more robust results. However, despite this weakness, the present research provides several findings that challenge some of the workplace research's taken for givens, for instance the assumption that so-called NewWoW is the answer to most workplace challenges. The present research provides several strong arguments for cell offices with permanent positions, particularly for knowledge workers with concentration work who spend many hours per week at the workstation. Thus, further research is needed.

The present research's main finding is that knowledge workers' office types should be differentiated according to their work tasks and work patterns. The present research also indicates that need for support facilities is highly dependent of the kind of offices and workstations provided. There may also be age or generation effects that have to be taken into consideration.

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Figures

Figure 1: Scores on F5 Workstation efficiency given the respondents' type of office and hours per week at the workstation

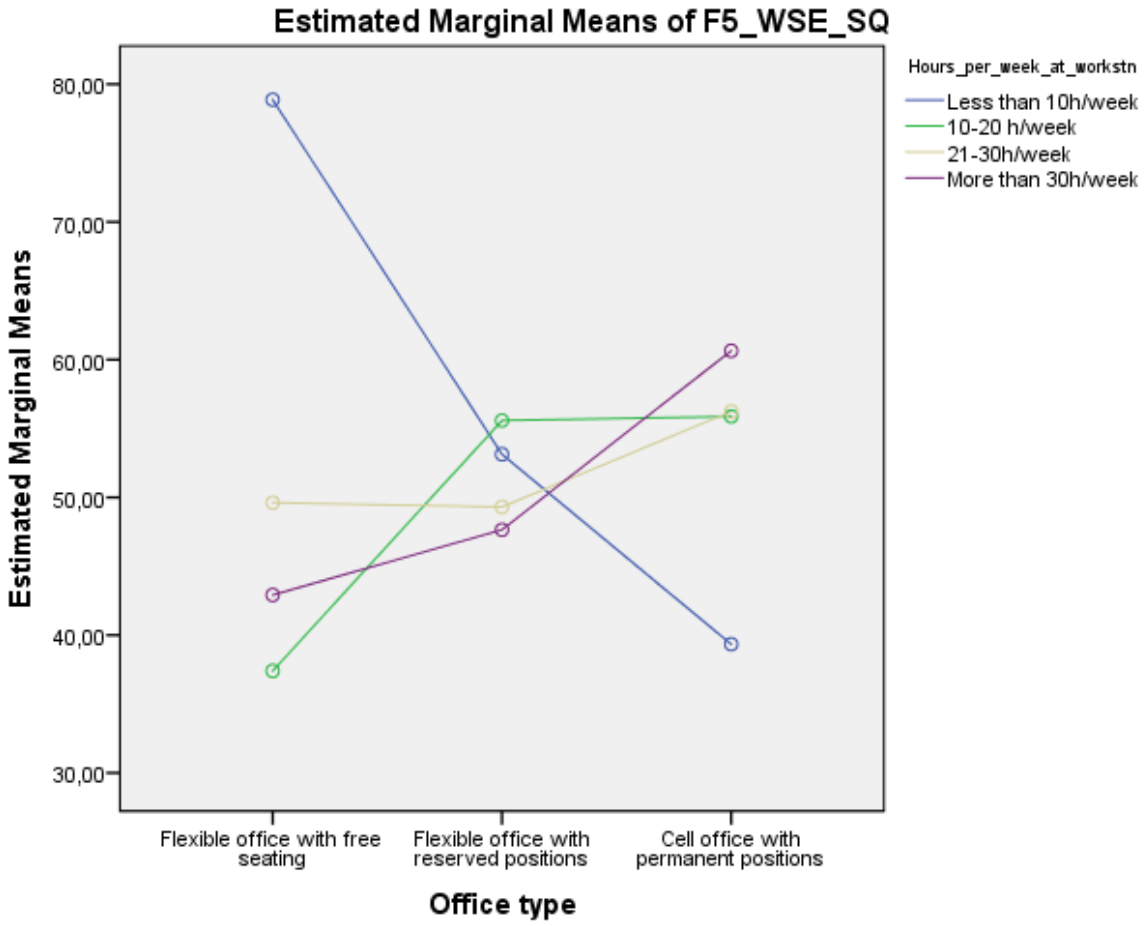


Figure 2: Scores on F5 Workstation efficiency given the respondents' Type of office and Age

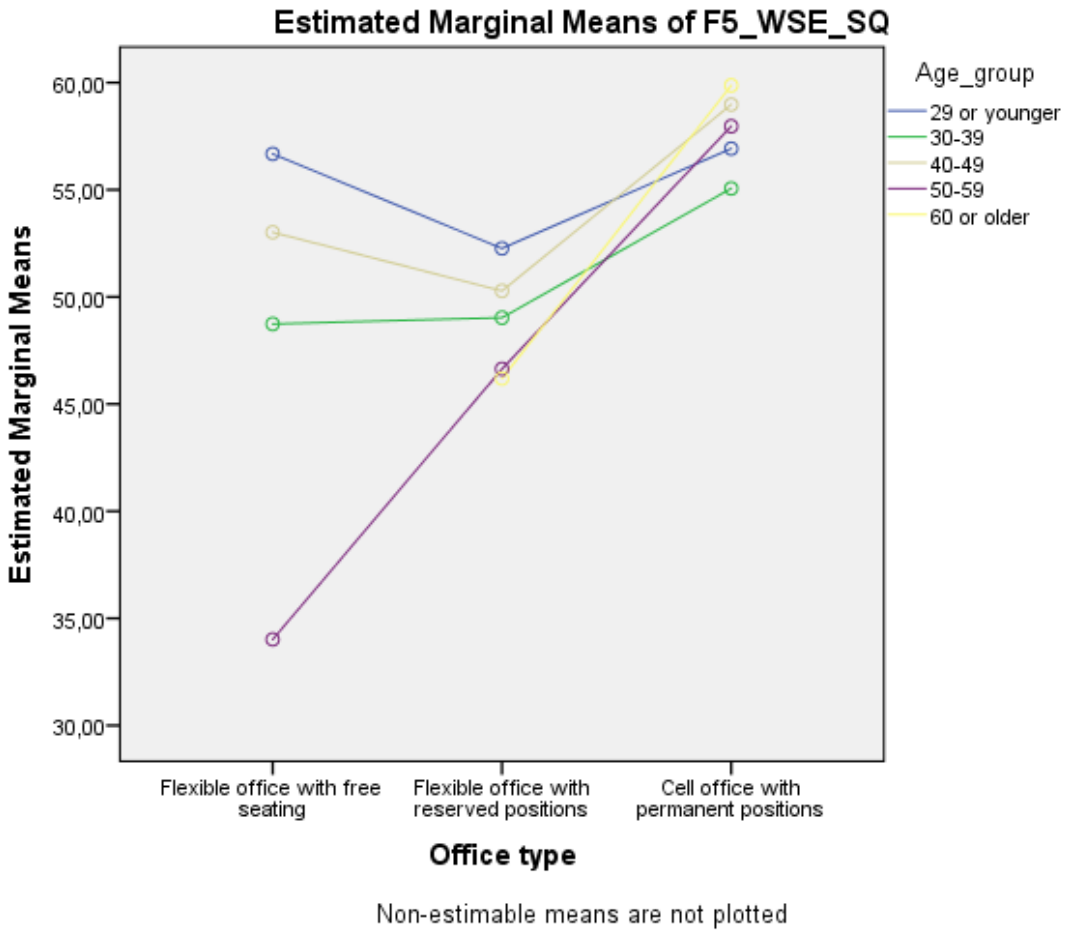


Figure 3: Scores on F7 Workplace design effectiveness given the respondents' type of office and hours per week at the workstation

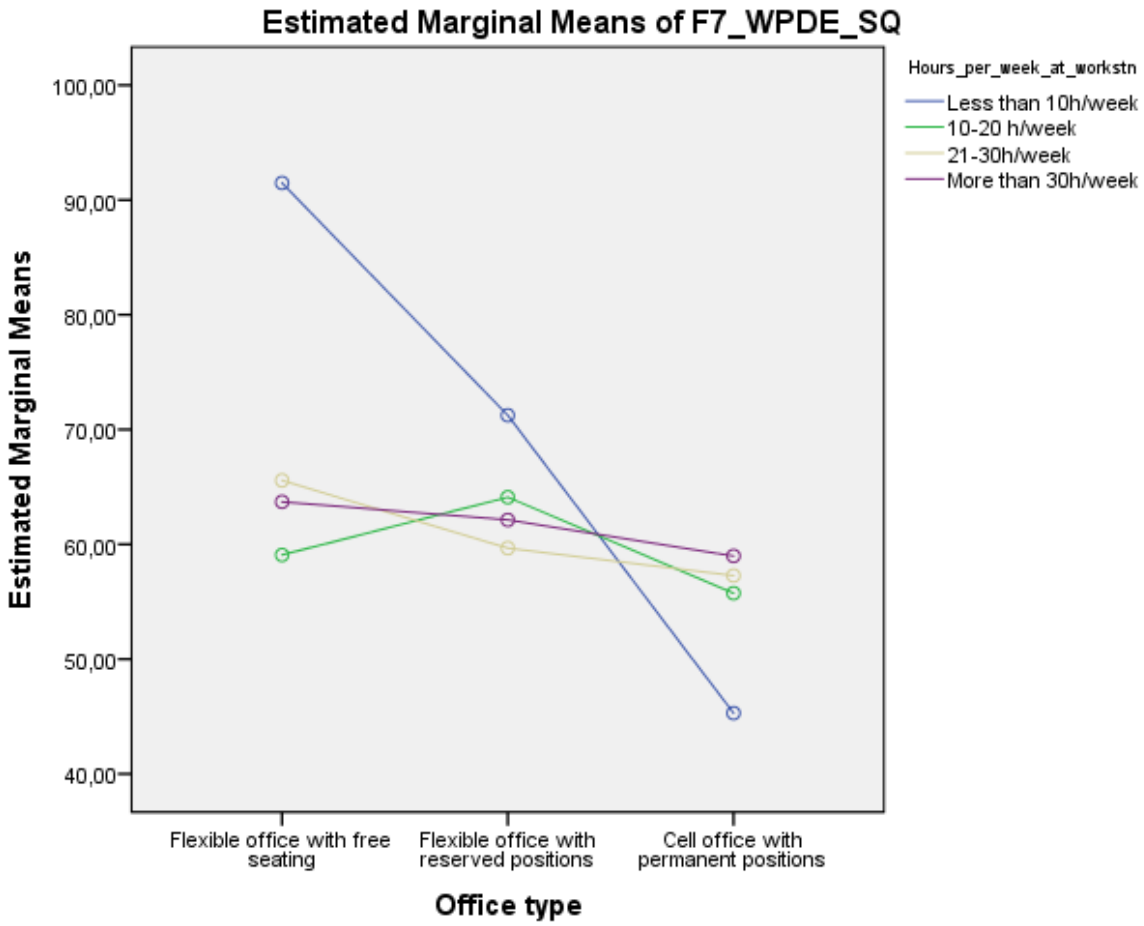


Figure 4: Scores on F1 Common areas given the respondents' type of office and hours per week at the workstation

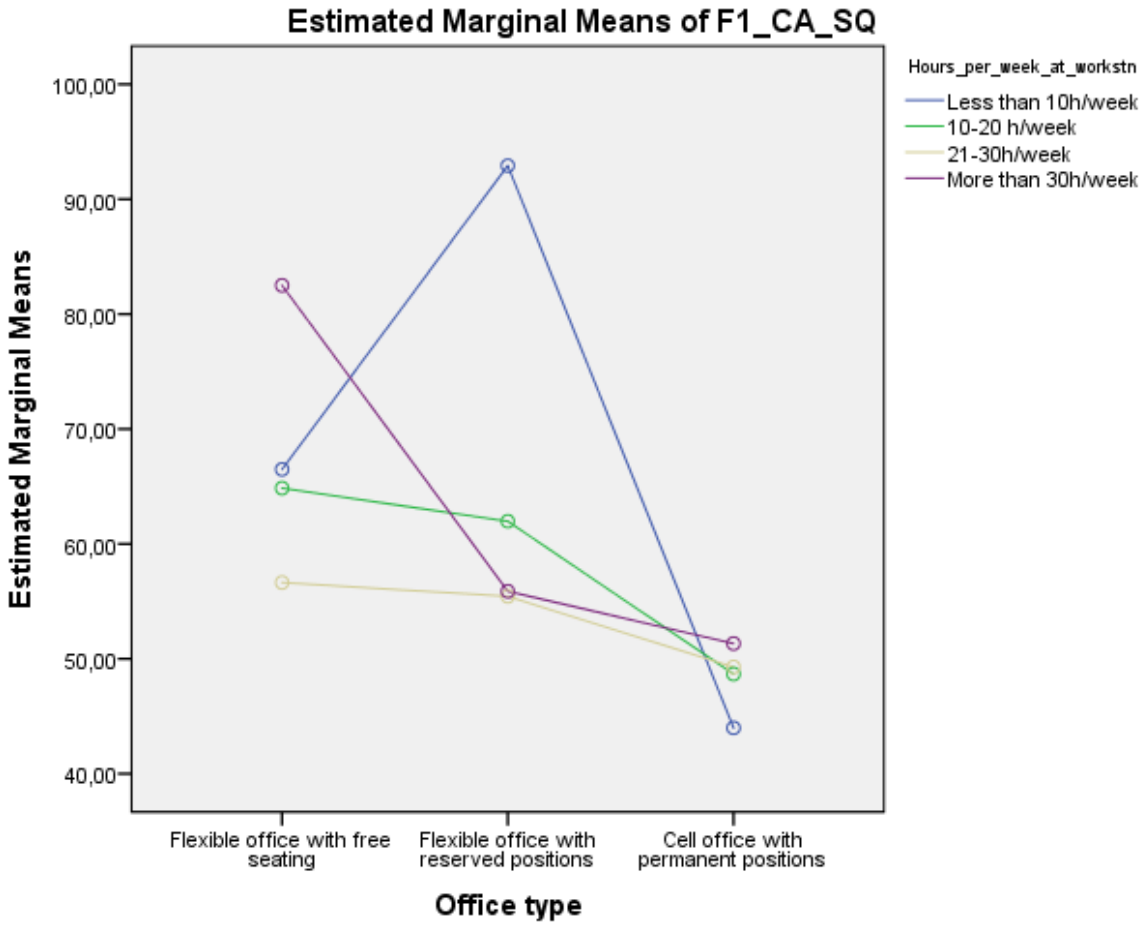


Figure 5: Scores on F1 Common areas given the respondents' type of office and age

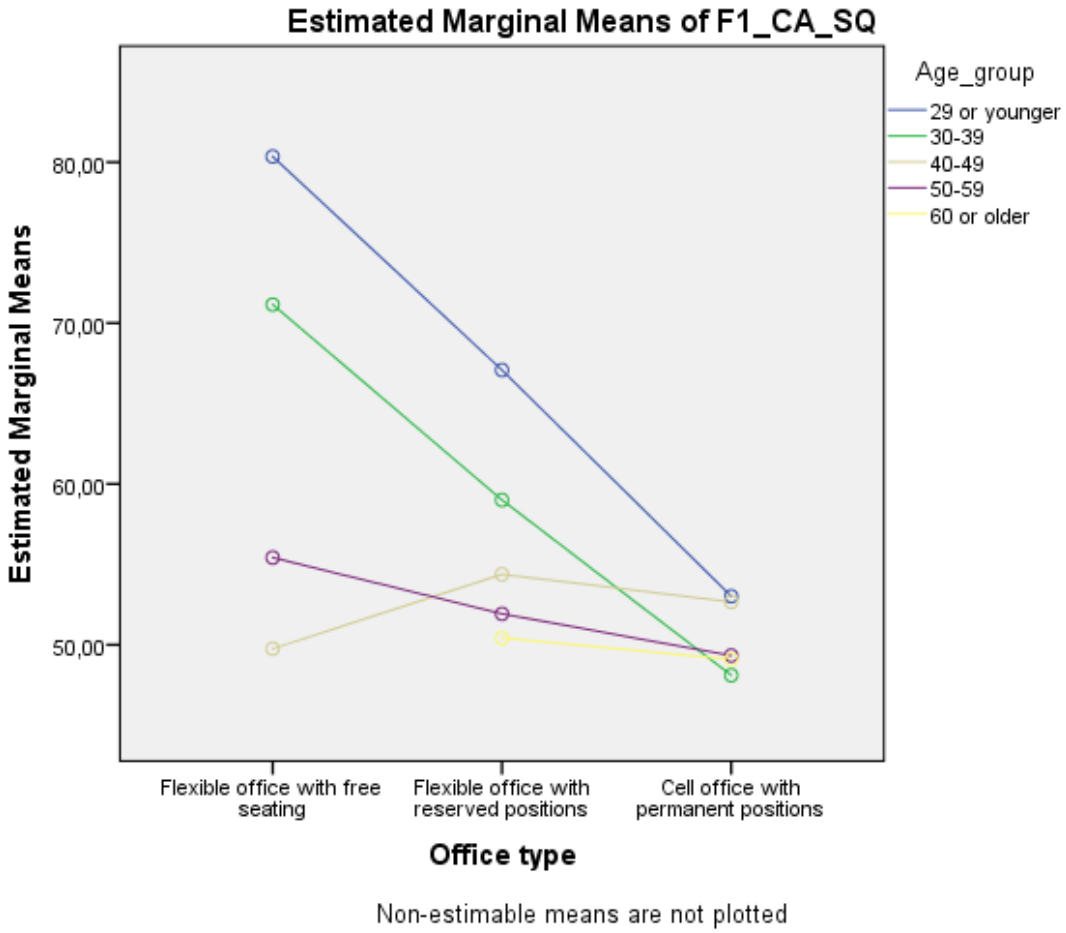


Figure 6: Scores on F4 Seclusion rooms given the respondents' type of office and hours per week at the workstation

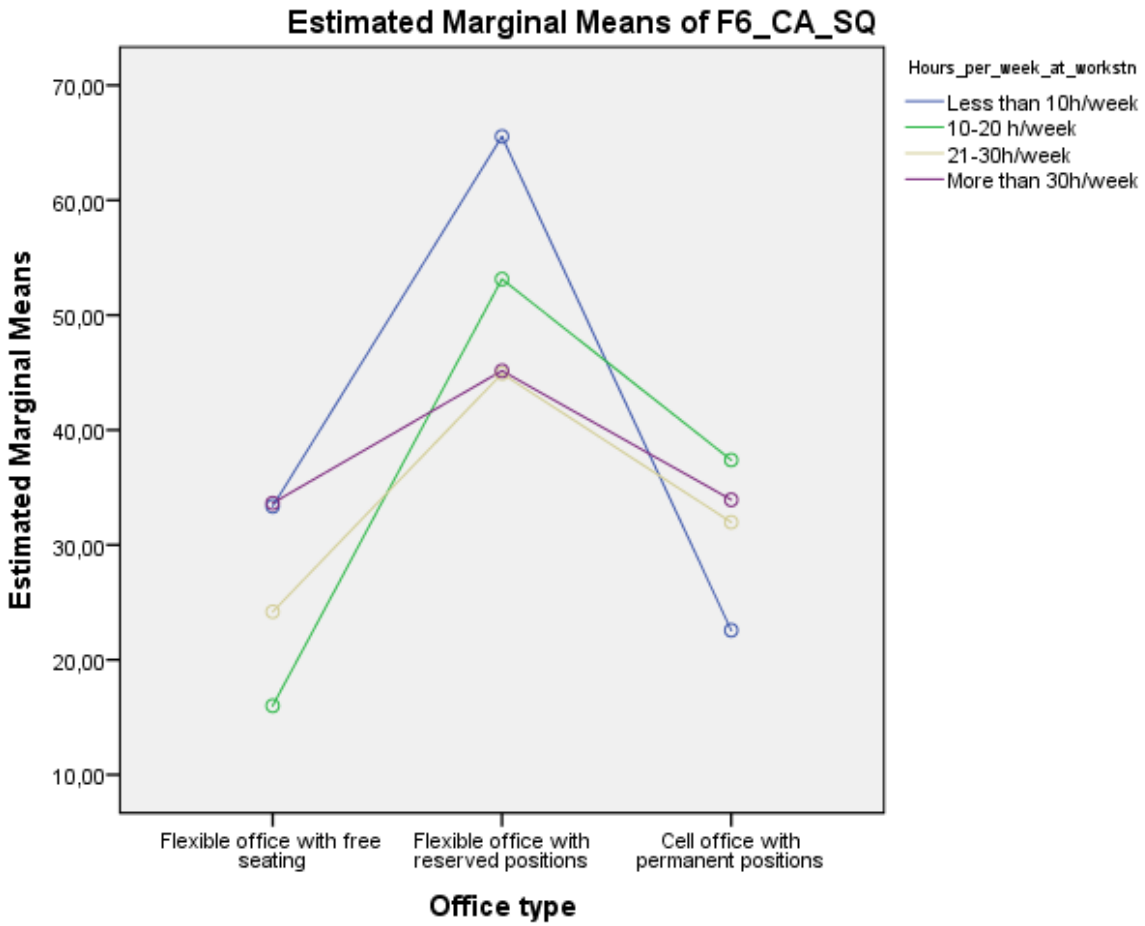


Figure 7: Scores on F4 Seclusion rooms given the respondents' office and age

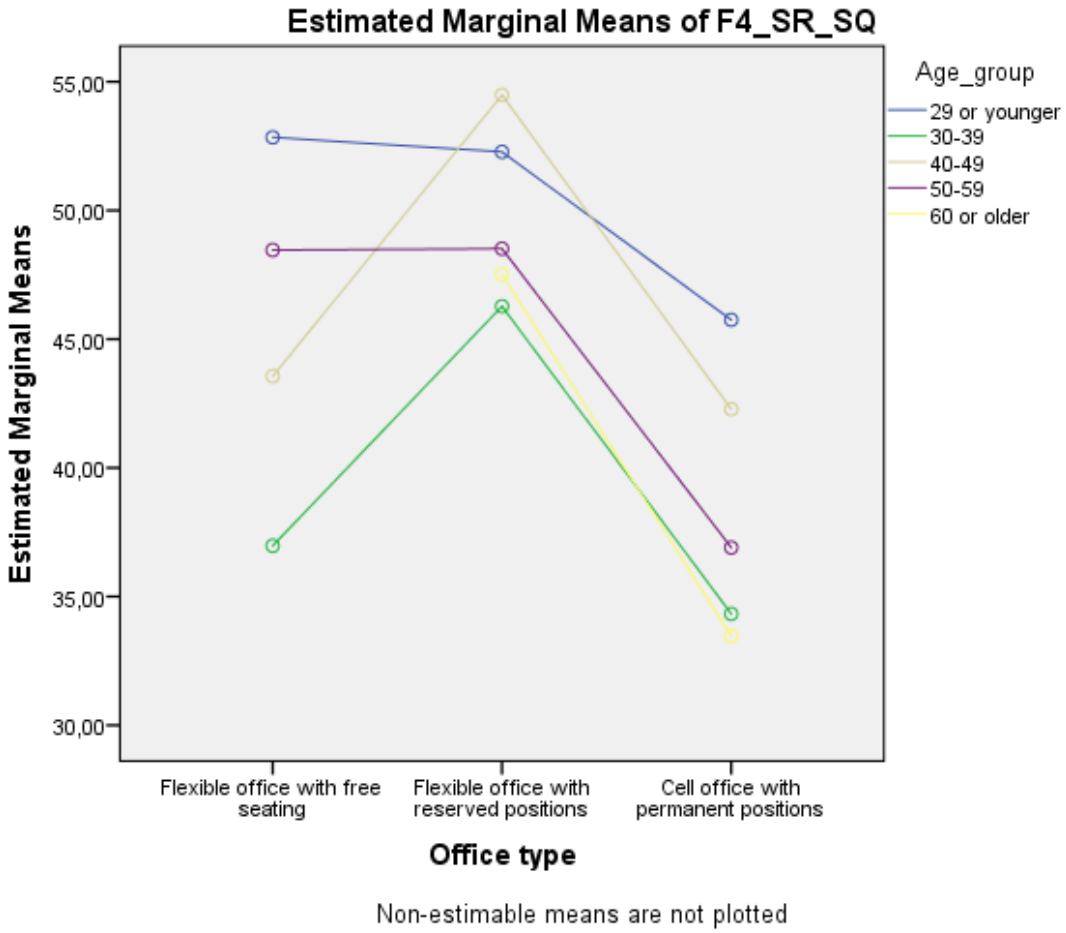


Figure 8: Scores on F6 Canteen given the respondents' type of office and hours per week at the workstation

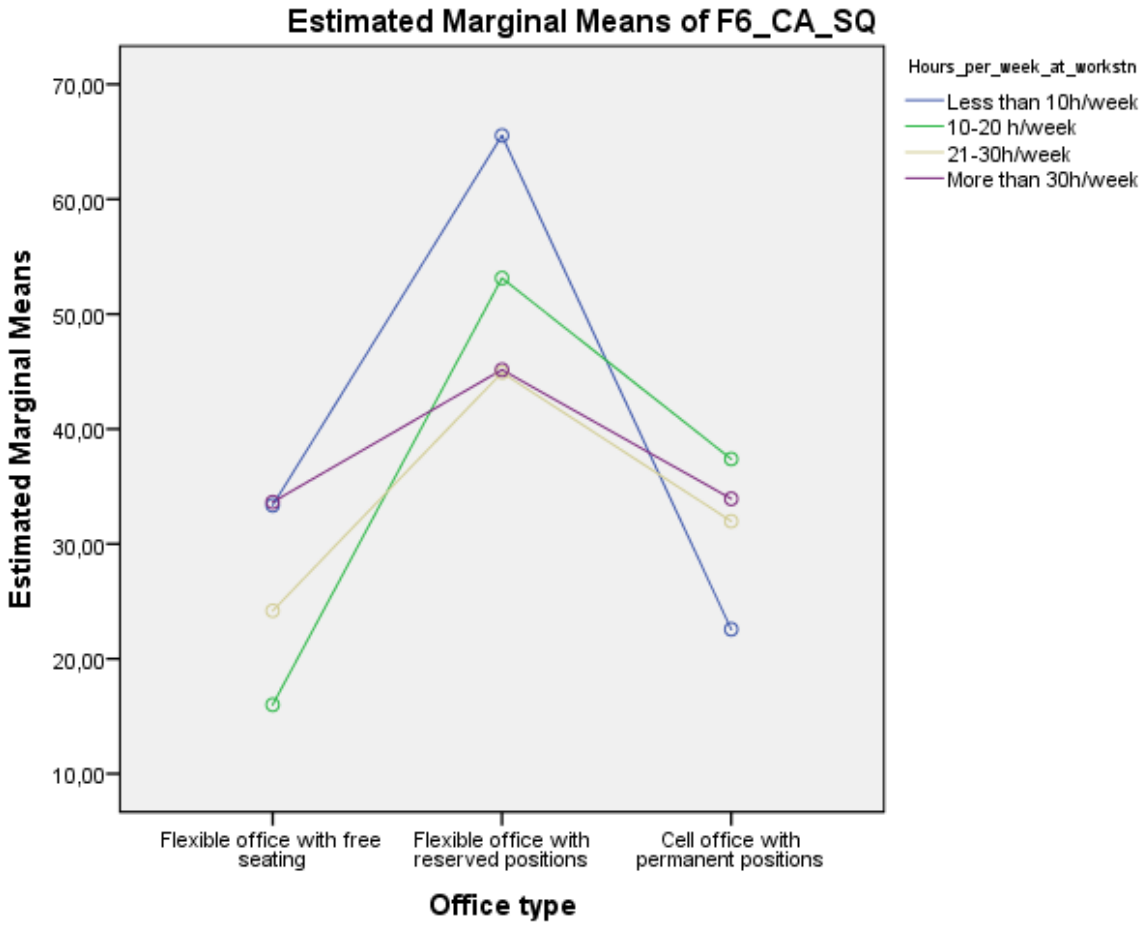
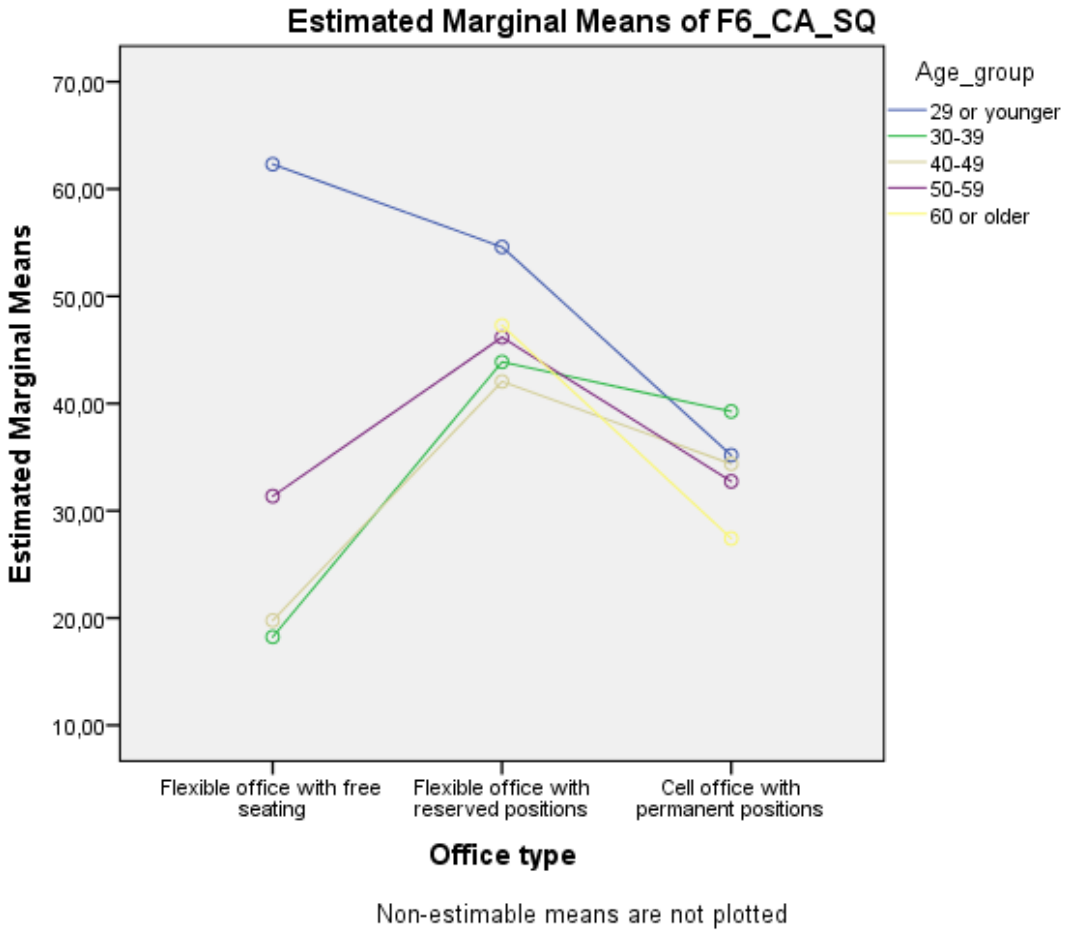


Figure 9: Scores on F6 Canteen given the respondents' type of office and age



Tables

Table 1 The respondents' offices

	Flexible office with free seating (%)	Flexible office with reserved positions (%)	Cell office with reserved positions (%)	Total (%)
Institution for research and higher education	44 (4.6)	53 (5.6)	850 (89.8)	947 (60.6)
Consultancy company (L)	5 (0.9)	368 (64.2)	200 (34.9)	573 (37.6)
Consultancy company (M)	1 (2.4)	38 (90.5)	3 (7.1)	42 (2.7)
Total	50 (3.2)	459 (29.4)	1053 (67.4)	1562 (100.0)

Table 2 The respondents' weekly use of their workstations

Organization/employees	More than 30 hours (%)	21-30 hours (%)	10-20 hours (%)	Less than 10 hours (%)	Total
Institution for research and higher education					
Technical/administrative employees (included managers)	168 (51.9)	108 (33.3)	40 (12.3)	8 (2.5)	324
Researchers and teachers	207 (43.4)	163 (32.2)	84 (17.6)	23 (4.8)	477
Consultancy company (L)					
Top managers	1 (25.0)	2 (50.0)	1 (25.0)	0 (0.0)	4
Middle managers	36 (43.4)	32 (38.6)	12 (14.5)	3 (3.6)	83
Administrators	27 (71.1)	8 (21.2)	2 (5.3)	1 (2.6)	38
Project staff	268 (74.4)	75 (20.8)	11 (3.1)	6 (1.7)	360
Consultancy company (M)					
Top managers	0 (0.0)	2 (66.7)	1 (33.3)	0 (0.0)	3
Middle managers	5 (50.0)	4 (40.0)	1 (10.0)	0 (0.0)	10
Administrators	6 (85.7)	1 (14.3)	0 (0.0)	0 (0.0)	7
Project staff	16 (94.1)	1 (5.9)	0 (0.0)	0 (0.0)	17
Total	734	396	152	41	1323

Table 3 Factors and constructs established through EFA

Factor/Construct	Factor loadings	No. of items	Valid N	Cronbach's alpha	M	SD
F1 Common areas	.820-.672	8	601	.950	52.41	28.10
F2 Ventilation and temperature	.900-.819	8	1299	.968	52.99	28.80
F3 Freedom of choice	.881-.594	6	900	.944	64.18	26.92
F4 Seclusion rooms	.877-.483	6	607	.930	43.61	27.49
F5 Workstation efficiency	.851-.691	4	1290	.926	54.97	25.73
F6 Canteen	.785-.683	5	868	.926	37.52	27.19
F7 Workplace design effectiveness	.775-.646	3	1276	.928	59.21	26.94
F8 Meeting rooms	.793-.408	5	981	.915	48.77	25.75
F9 Lighting	.810-.640	4	1320	.946	55.89	27.56
F10 Office leisure	.793-.337	2	1164	.979	38.04	29.31
F11 Acoustics	.823-.804	2	1419	.977	51.56	31.72
F14 Adjustment of indoor climate	.485-.458	3	1434	.807	66.66	26.72